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R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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BEAUTY AFIELD

Better Crops with PLANT FOOD

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VOL. XXXII WASHINGTON, D. C., JUNE-JULY 1948 No. 6

Celebrating a . . .

Centenary

Jeff McDermid

OUT in my native State, folks everywhere are celebrating the one hundredth anniversary of the year 1848, when Congress admitted that commonwealth to the Union, with full rights, privileges, and terrible unforeseen responsibilities. Right now, what with a soaring revenue from "bloated" incomes (compared to some other times we have all experienced) the State and its subdivisions are in pretty nice shape to spend a little spondulix on the fireworks.

I am feeling right smart over the centennial, partly because my own Mother was born in that same anniversary year 1848, and also because I was a schoolmate of the present governor and have had good relations for a long time with the committee chairmen who are staging the big blowout at the State Fair in August. Moreover, and what is even better, I can call a lot of citizens by their first names and pet nicknames —people who perform the everyday tasks that mold public opinion and guide the public action, which really makes the State worthy of a proud backward review. What with those things and the fact that my wife and children, myself and even my in-laws, were born in the State adds to the natural interest I have in what's going on.

Now I am aware that just an even 100 years of time doesn't mean so much in the universe, and that lots of other places that folks are proud of are also observing centennials, and even double or triple that span of years. The spot where I hang my hat and pay my rent is now scheming up a big jamboree in 1949 to set forth 200 years of corporate existence. You can plot any period of the past and brag about it, but the main idea is to try and help fix things so that

the present and future are worth more than the past in terms of human welfare and social betterment. "The past is prologue."

In that connection I am sure that some folks who did a heap to set things right and toiled hard to follow some bright star of hope in an obscure way are not going to be lauded by any speakers at this or any other centennial; but let's not forget them in the mass anyhow, or fail to pay silent homage to them as the bands go by.

AS for myself, I never ran for any public office in any section of the State government, so I am unable to point with pride to any career of administration. It's probably just as well, as I had plenty of neighbors who made better dog-catchers and coroners and aldermen than I might have been; and I was thus saved from the bitter sting of defeat.

Yet my friend, the able and successful governor in reality can be just as proud of the humble immigrant farmers and storekeepers who laid the groundwork of his own and the State's career, as he can possibly be of any of his own achievements. That is, he can lean back in his leather chair up there in that fancy room that has been decorated like a Venetian palace and dream back to the times when his forebears came across the sea in barkentines or schooners with a few belongings and heaps of energy to face a questionable but promising struggle behind the plow and the counter. They settled within half an hour's motor ride from the Statehouse, and accepted the challenge of a raw country. He, like some other governors we have had, finds his fame resting on the soil and the tillers thereof. In fact, he's had a little barnyard sun tan on his neck himself.

Your honest historian—and there are plenty of eager amateurs studying the scroll of time in old newspapers up there this summer—is obliged to admit that the scars and mistakes one ravels from the records are just as much a part of the picture as the musty speeches and patriotic incidents and industrial progress which usually get the limelight.

Some of my knowledge of minor happenings that are largely obscured in this glorified celebration come from the stories and memories of my Father and Mother. My folks were far better at personal reminiscences than they were at money-making. Hence my main heritage from them has not been in bank balances or property rights, but in the mellow traditions that spring from living and experiencing the passing show. It consists of remembrance of queer characters and odd personalities of the long ago. Like Shanghai Chandler, bibulous newspaper reporter, who used to rise and flap his wings and crow after each telling phrase in some bigwig's speech. Or N. H. Wood, the pioneer merchant prince, who built himself a marble hall garnished with fountains and statuary out of the proceeds of a lifetime selling stuff to farmers. The figure above the front porch was Pomona, goddess of the harvest, truly a proper emblem.

BECAUSE these parents of mine stored up memories rather than money, every acre of land they ever had title to has gone into other hands, and we do not own a square yard of ground in the State to which I may retire, except a peaceful lot in a cemetery overlooking the broad river, which land as far as I know is not taxed. My two Original Friends lie in that safe haven now, on a grassy hilltop spattered with violets and refreshed with the summer breezes that rise from the stream, along which most of their lives were spent.

The tales they told me remain in blurred but convincing form. Had I then possessed the yen for taking notes and being accurate like my later reporting years inspired, I could dish up a book of facts to embellish the present centennial with startling and disconcerting truths. For when the closet

door is opened all things therein may not be neat and orderly. Some of the garments left in there would be too moth-eaten and ragged to wear this year on dress parade. Yet this is the stuff that fireside yarns are made of, and on which we rely for a vivid human panorama.

One harrowing tale relates to the "Injun" scare. The uprising of Little Crow in the Fort Ridgeley affair across the Mississippi sent chills chasing along the spines of scattered settlers. It sent

couriers riding day and night and caused families to quit the lonely farms for handy stockades. My mother saw a neighbor boy rip up all his garden patch in July, so that the "dumb Injuns" wouldn't get his taters and rutabagas. She saw farmers bury their treasures and throng into groves to camp together for security.

She saw her brothers, one by one, march off to war and leave her mother with two teen-age children to meet the threat of anxiety and inflated prices alone. She saw drought and poor crops and penniless people, shielding each other as best they could during an era of peril and sacrifice. She and her mother "took in" plain sewing and mending, and finished the seams and stitches through months of weariness, hunger, and tears. Yet even through the tears she noted the funny incidents and the lighter moments, and repeated them to me with great gusto and rare mimicry. Such as the old and feeble neighbor, a veteran of the Lundy's Lane affair in the War of 1812, who wrote the governor for a commission; and the fussy fat woman who sat on their best chair and broke it.

Then sometime later there were murders and lynchings in the quiet town, still red and raw from war's effects. She told me often about the ex-captain of infantry who had turned lawyer and was constantly harassed by a private soldier of his old company, whom he had kept in the guardhouse frequently. It culminated finally in the shooting of the former soldier by the exasperated lawyer half way down Main Street, and his immediate lynching by a bitter and revengeful mob. I recall the poplar tree near the livery stable where my mother said the body swayed untouched until the dawn. Yet a second lynching occurred, when a trainload of irate citizens ran a few cars down the rails from the next town and swept into the county jail, to yank out a local footpad, who had killed and robbed a wayfarer, the week before. Here again, even in my time, there was a certain tall tree marking the gibbet on which popular fury took its hasty and illegal satisfaction. How these mobsters managed to control a regular train to work their revenge or how none paid penalty for the misdeed is still unanswered.

IF any budding historians or thesis writers desire to have the place, names, and approximate dates of these human sacrifices to public violence, it will be easy to supply them. But I hasten to add, however, that court judges have since meted out official justice in that now orderly town.

My Father's memories featured his boyhood of play and hunting, some of his chums being young Winnebago Indians, and went on from there to oft-repeated anecdotes of wartime, about this and that wild foray along the big river, sleepless nights spent in swamps,

(*Turn to page* 49)

Fig. 1. Cylinders of NH_3 in place and metering the gas into the irrigation system.

Applying Fertilizers in Solution

By M. E. McCollam and F. S. Fullmer

San Jose, California

THE practice of irrigation agriculture in the Western States was recognized as a means of applying fertilizer to crops many years ago. One of the first applicators to be used in conjunction with the irrigation system consisted of a hopper into which a soluble dry fertilizer material was dumped. A small amount of water introduced into the hopper formed a concentrated fertilizer solution which was released through a metering device into the irrigation water. Various applicators of this same principle could be found in use on California vegetable lands and orchards in the early years of this development. Even the method of cutting open a sack of fertilizer and tossing it into the irrigation ditch has been used to accomplish fertilizer distribution.

The application of dry materials, already dissolved materials, gases, and acids through the irrigation system is now a common procedure and one that has been developing rapidly during the past five years.

The use of liquid mixed fertilizer may be considered a new development, although the first plant for manufacturing fertilizer of this type was built about 25 years ago. The G. and M. Liquid Fertilizer Company, established in Oakland in 1923, was the first company of this type in California. The fertilizer produced was used almost exclusively by Japanese truck farmers, either alone, or as a supplement to the regular dry fertilizer program. The second plant, Liquid Plant Food Company, which is still in operation, was started in Pasadena in 1929. Initially all of the liquid fertilizers produced at

TABLE I.—COMPARISON OF LIQUID FERTILIZER TONNAGE WITH OTHER FERTILIZERS SOLD IN CALIFORNIA, 1943-1947 *

Year	Liquid Phosphoric Acid	Liquid Mixed Fertilizer	Dry Mixed Fertilizer	Total Tonnage All Fertilizer
	Tons	*Tons*	*Tons*	*Tons*
1943	1,101	967	147,778	301,497
1944	.....	2,170	183,696	420,368
1945	2,552	4,310	250,690	483,716
1946	3,574	5,200	281,177	570,220
1947	5,170	7,744	234,762	594,086

* Tonnage figures from reports of Bureau of Chemistry—California State Department of Agriculture.

this plant were used on citrus. Later the use spread to truck crops, and at the present time over 70 per cent of the Liquid Plant Food Company production is used to fertilize vegetables.

Almost 15 years ago anhydrous ammonia (NH_3) was marketed in California as a fertilizer material by Shell Chemical Corporation. This marked the beginning of a rapid increase in the use of nitrogen in this form, and today it is a common sight to see the cylinders containing this material placed along irrigation ditches, metering nitrogen into the irrigation water.

Whereas before this material's use was limited to irrigated land, the development of a method of applying NH_3 directly to the soil has extended the market to non-irrigated lands. This marks a departure which promises to further expand the market for "liquid" fertilizers.

In California there are now at least 30 fertilizer companies distributing fertilizer and soil amendments in "liquid" form including solutions of dry materials, NH_3 gas, sulfur dioxide, liquid phosphoric acid, and nitrogen solutions. Other materials have recently appeared on the list also. The application of these materials in irrigation water is not only being made to truck crops and orchards, but in addition to some field crops such as sugar beets, flax, and cotton.

While the Western use of this type of fertilizer application is most extensive in California, it is not limited to this State, and to the writers' knowledge is being employed in Oregon, Washington, and Arizona as well.

Liquid mixed fertilizers comprised a little over three per cent of the total mixed fertilizer tonnage in 1947.

While no figures are available in California on the tonnage of NH_3 used as such, there were 8,883 tons of nitrogen solution marketed presumably for direct application in 1947. It would probably be a fairly close estimate to say that about six per cent of the total

Fig. 2. Liquinox Company, Orange, California, filling small containers from a storage tank of 8-8-4 liquid mixed fertilizer.

fertilizer tonnage sold in 1947 was applied as "liquids."

Liquid "complete" fertilizers are mixed in wooden vats, ranging in size from 300 to over 1,000 gallons in capacity. Some dry materials that are slowly soluble in cold water are first dissolved in steel tanks with the use of heat. Liquid materials obtained in tank-car lots are stored in large wooden vats or steel tanks. These materials, along with liquids obtained in barrels or drums, are used in the regular mixing operation. After mixing, the fertilizers are either pumped into storage tanks with 3,000- to 6,000-gallon capacity, or put directly into barrels, drums, or other containers for delivery to the field.

In California most of the grades produced by dry fertilizer manufacturers are obtainable in the liquid form. With the materials available, some of the liquid grades are sometimes subject to precipitation or crystallization, with any marked drop in temperature. This is considered a minor problem. One company employs a full-time control chemist, while others engage the services of commercial laboratories.

Nitrogen in liquid mixed fertilizers is derived from ammonium nitrate, urea, nitrogen liquors, and potassium nitrate. Liquid phosphoric acid is used almost exclusively for the phosphoric acid portion of liquid fertilizers, although some ammonium phosphate and other soluble phosphates are used in special mixes. A few plants use potassium nitrate as a source of potash, while the majority use muriate of potash or a combination of the two.

Some experimental work is being carried on with new materials that would be more adapted to liquid fertilizer production. Two of these, potassium sulfide and tetra potassium pyrophosphate (50% P_2O_5 and 40% K_2O) both show considerable promise. The

(*Turn to page* 46)

Fig. 3. Cart in place applying fertilizer in irrigation system. Note metering device on top of tank, also dry N cylinder beneath tank for developing pressure.

Response and Tolerance of Various Legumes to Borax and Critical Levels of Boron in Soils and Plants[1]

By H. T. Rogers[2]

Agricultural Experiment Station, Auburn, Alabama

SEVERAL FACTORS served to stimulate boron research in the Southeastern States within the last decade. Reduced emphasis on cotton and a gradual increase in legume acreages pointed up new fertility problems when some of these crops with more exacting nutrient requirements than cotton or corn were expanded to include soils of low inherent fertility.

Early work with boron on alfalfa and root crops (6, 9, 30, 38) in other sections of the United States suggested the need for boron on the coarse-textured red and yellow podzolic soils of the Southeast if diversified crops were to be grown. Also, reports by Naftel (24) and others (21, 22), which associated overliming injury to legumes with boron deficiency on some soils in greenhouse tests, stimulated efforts to determine how widespread these effects were in the field and to what extent this depressing effect of lime served to limit legume yields.

Probably the first report (26) that boron applications would increase seed production of crimson clover was issued in 1942. This immediately suggested the possibility of adding boron for crimson clover production in the Coastal Plains area, where many disappointing failures with this legume had been experienced.

Stemming from the early work on alfalfa, it is recommended in several states that borax be included in fertilizer mixtures for this crop. The New Jersey Experiment Station (34) recommends that five pounds of borax be added to every ton of mixed fertilizer sold in the State. In order to find out whether recommendations of this type would be desirable in Alabama, it was necessary to determine the value of borax for a variety of legumes on the major soils of the State, as well as its residual effect and tolerance of most of the important agricultural crops to borax. All of these developments emphasized the need for more information on the boron status of the soils and the boron needs of a variety of crops.

[1] The experimental results discussed herein were reported in more detail in two articles which appeared in the Journal of the American Society of Agronomy 39: 897-928, 1947. This work was supported in part by a research grant from the American Potash Institute.

[2] Associate Soil Chemist, Alabama Agricultural Experiment Station. Since January 3, 1947, Agronomist with the Tennessee Valley Authority. The author gladly acknowledges assistance in conducting the field tests reported herein from: E. H. Stewart, D. G. Sturkie, S. E. Gissendanner, H. R. Benford, E. L. Mayton, Otto Brown, H. R. Albrecht, and F. E. Bertram of the Experiment Station Staff and Cooperating Extension Service county agents and Soil Conservation Service technicians. Claude Morris, William Rawson, and Clarence M. Wilson assisted with the laboratory determinations.

Fig. 1. Effect of borax on stand of bur clover (manganese strain). A. Response to 12 lbs. of borax per acre on Cahaba loamy sand. Bur Clover seedlings which came up to a good stand in September died out completely on the no-borax strip (center) by February when this photograph was taken. B. Left, no borax at time of seeding resulted in loss of stand of clover due to severe boron deficiency of Norfolk loamy sand. Photographed in March 1944.

The boron research of the Alabama Agricultural Experiment Station from 1942 to 1946, dealing largely with field experiments on alfalfa and several winter legumes and correlated laboratory studies on available boron in the soil and boron in the plants, has been summarized. Reported first are the results of the field tests, showing the boron needs of a variety of legumes. The second phase of the study compares field response with soil and plant analyses in an attempt to evaluate methods for selecting boron-deficient areas. Finally, methods of placement of borax to avoid injury to plants and the tolerance of several legumes to borax are discussed.

The legumes tested include alfalfa (Medicago sativa), bur clover (Medicago arabica), crimson clover (Trifolium incarnatum), red clover (T. pratense), white clover (T. repens), Austrian winter peas (Pisum arvense), blue lupine (Lupinus angustifolius), hairy vetch (Vicia villosa), monantha vetch (Vicia monantha), soybeans (Glycine soja), alyce clover (Alysicarpus vaginalis), peanuts (Arachis hypogaea), and sericea (Lespedeza cuneata).

Response by the Medicagos—Alfalfa and Bur Clover

Alfalfa produced on the average 58 per cent more hay where borax was applied, responding on 12 of the 13 fields (Table I). This represented an average increase of 1,807 pounds of alfalfa hay per acre per year for the addition of 20 to 30 pounds of borax at time of seeding. A single application of borax was effective in increasing the hay yields for two to three years (Table II). The cost of this treatment was insignificant when compared with the returns in increased hay yields. Average annual yield increases of two to three tons per acre were obtained at two locations. Very few investigators have reported responses of this magnitude, even on the true podzols in the Northeastern States which are known to possess high boron-fixing capacity.

A rosetting of the terminal bud growth was frequently the first evidence of boron deficiency in alfalfa. Later, severe "yellows" accompanied by pinkish-colored leaves developed, with a resulting loss of stand where these severe deficiency symptoms were observed.

In view of the response to borax

obtained in extensive tests (1, 7, 9, 11, 12, 13, 14, 15, 20, 36, 38) in other sections of the country it was not surprising that alfalfa showed the need for additions of boron on most of the Alabama soils tested. Aside from the root crops alfalfa is the one crop that has shown need for applications of boron under more varied soil and climatic conditions than any other one agricultural crop. Up until the present time, this is the only field crop for which statewide recommendations for the addition of borax have been made in Alabama.

In New York where several hundred field tests were conducted, Dawson and Gustafson (11) reported that borax applications did not increase alfalfa yields appreciably, although boron deficiency symptoms were observed in 17 per cent of the tests. Brown, Munsell, and King (7) reported a 21 per cent increase in yields from five fields in Connecticut, but no increase on six other fields. Reeve, Prince, and Bear (34) recommend that five pounds of borax be added to every ton of mixed fertilizer sold in New Jersey, where they obtained response to borax in 12 per cent of the 450 fields tested with various crops including alfalfa. Dregne and Powers (12) reported increases in alfalfa yields ranging from 10 to 37 per cent from the application of borax. Powers (30) reported that boron applications raised the chlorophyll content of alfalfa plants 50 per cent.

The response of alfalfa to borax suggested that bur clover, another member

TABLE I.—RESPONSE OF VARIOUS LEGUMES TO BORAX AND WATER-SOLUBLE BORON IN THE SOIL

Crop	Number of locations tested		Response to borax		H_2O – soluble boron in soil, ppm
	Total	Responding	Increase, lb. per acre per year [1]	Per Cent increase	
Responding group					
Alfalfa	13	12	1,807	58	0.07
Bur clover	10	7	4,773(G)	104	0.09
Crimson clover (seed)	10	10	259	244	0.06
Vetch (seed)	4	4	247	80	0.07
Red clover [2]	3	1	210	16	0.07
White clover	1	1	753	158	0.08
Nonresponding group					
Austrian winter peas	12	0	−342(G)	−4	0.06
Blue lupine	4	0	109	1	0.06
Peanuts (nuts)	2	0	−67	−5	n.d. [4]
Soybeans [3]	1	0	609	13	0.05
Alyce clover	1	0	−846	−25	0.05
Lespedeza (sericea)	1	0	−330	−12	0.05

[1] Increase over no borax in pounds per acre of air-dry material except where designated by (G) for green weight of bur clover and Austrian winter peas.
[2] Red clover put in responding group primarily because of marked B deficiency symptoms on one location which was corrected by the addition of borax.
[3] Soybeans followed crimson clover on a soil which was highly deficient in B for the clover. Residual effects from increased clover growth would account for the slight increase in soybean hay yields.
[4] Not determined.

TABLE II.—YIELDS OF ALFALFA OVER SEVERAL YEARS WITH NO BORAX, INITIAL APPLICATION ONLY, AND INITIAL WITH ANNUAL APPLICATION

Soil type	Borax, lb. per acre [1]		Yields of hay and increases for annual applications,[2] lb. per acre											
			1st year		2nd year		3rd year		4th year		5th year		Average	
	Initial	Annual	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase
Auburn strip test														
Norfolk loamy sand	0	0	1,905		7,200		986		Test discontinued				3,363	
	20	0	2,980		10,732		8,552						7,421	
	20	10	3,069	89	10,192	−540	6,964	−1,588					6,742	−679
Auburn bins														
Norfolk loamy sand	0	0	1,479		8,539		5,037		Test discontinued				5,018	
	20	0	6,270		12,807		6,245						8,440	
	30	0	6,255	−15	12,480	−327	6,487	242					8,407	−33
	20	20	5,425	−845	12,339	−468	7,075	830					8,280	−160
North Auburn strip test														
Madison clay loam	0	0	Reseeded test		3,919		3,525		Test discontinued				3,722	
	20	0			6,458		6,883						6,671	
	20	10			6,183	−275	6,747	−136					6,465	−206
Sand Mountain Substation (general field)														
Hartsells fine sandy loam	0	0	7,040		4,860		3,810		5,000		9,180		5,978	
	15	15[3]	7,780		6,590		4,330		5,830		10,720		7,050	
	30	30[3]	7,930	150	7,290	700	4,370	40	5,790	−40	10,930	210	7,262	212
Sand Mountain Substation (strip test)														
Hartsells fine sandy loam	0	0	1,800		2,150		3,900		10,125				4,494	
	20	0	3,175		3,425		4,950		10,825				5,594	
	20	10	3,550	375	3,575	150	5,550	600	10,550	−275			5,806	212

[1] All plots received one ton of ground limestone per acre. Rates of phosphate and potash varied some at different locations but approached minimum for maintenance of stands.
[2] Increases or decreases in hay yields for annual application as compared with a single application of borax at time of seeding.
[3] Amounts applied every other year.

of the genus Medicago, might have similar boron requirements. With the exception of a reported borax response by California bur clover on some of the extremely sandy soils of Florida (18), no reports of extensive boron trials with bur clover were found.

The results of tests at 10 locations (Table I) show even more marked response to borax by bur clover than by alfalfa. The yield records show an average increase of 104 per cent in green weight from the application of borax. Bur clover seedlings came up in the fall and died out where no borax was applied on at least two locations (Figure 1). The results of these tests suggest that boron may have a role in aiding small clover seedlings to survive periods of insufficient rainfall such as occur frequently in the Southeastern States during the fall months. The addition of boron to bur clover on other areas was reflected in earliness and more vigorous growth (Fig. 3). It is believed that boron deficiency probably has accounted for many of the failures to establish bur

clover as a successful green manure or pasture crop, particularly on the sandy soils of the Southeast where it appears to be adapted when properly fertilized. The application of borax to this clover is fully as important as it is to alfalfa.

Boron deficiency symptoms on bur clover are not always specific and may be confused with cold injury during the early winter months. Figure 2 depicts severe boron deficiency of bur clover. The chlorotic leaves have a bleached appearance and frequently have a pinkish tint that eventually may become almost white.

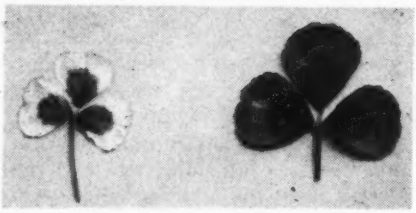

Fig. 2. Severe boron deficiency symptoms on manganese strain of bur clover as shown by chlorotic (pinkish-tinted) leaf, left, and normal leaf, right.

Response by the Trifoliums—Crimson, Red, and White Clovers

Borax was applied to crimson clover at 19 locations, mostly in central and southern Alabama. At 10 locations where seed yields were recorded, light applications of borax produced an average increase of 259 pounds of seed per acre (Table I). At the Main Experiment Station at Auburn, on a loamy sand where seed production was nearly a complete failure without borax, a four-year average increase of 760 pounds per acre was recorded. This increase was obtained from the average yields on 42 small plots with varying rates of lime, half of which received borax. At a number of locations borax produced no apparent effect on vegetative growth of crimson clover but increased seed production.

Because of the limited number of tests with red and white clovers, the results are interpreted only to indicate that these Trifoliums may benefit from an application of borax on sandy soils, if the material is applied at a light enough rate to avoid injury to stand.

Vetch Seed Production

The value of borax for increasing vetch seed production on soils low in native boron is shown in Table I. Vicia monantha and Vicia villosa (hairy) were each tested at two locations, giving maximum increases of 472 and 344 pounds of seed per acre, respectively from the use of borax. As noted with crimson clover, borax increased seed yields on some soils

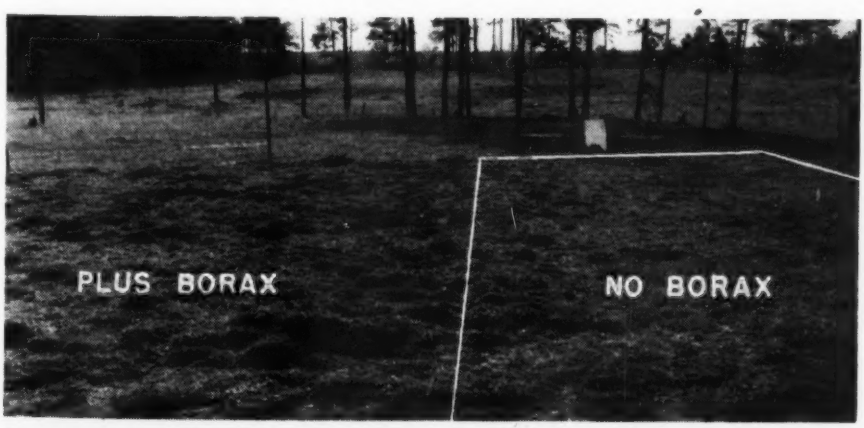

Fig. 3. Delayed growth of bur clover (southern giant) due to boron deficiency of Norfolk sandy loam. Photographed in March 1945.

where no response in vegetative growth could be observed. At one location, monantha, which is not as winter hardy as hairy vetch, showed less injury from cold where borax was applied.

The consistent and marked increases in crimson clover and vetch seed production from the addition of borax to these crops point to the need for extensive tests in the major seed-producing area of the State—the Tennessee Valley. If the Southeast as a region produces more of its legume seed requirements, a much more extensive use of boron will be needed. The possibility of boron stimulating seed production of a number of legumes which show no vegetative response should be investigated.

Nonresponding Legumes

Prior to the introduction of blue lupine in southern Alabama, Austrian winter peas was one of the major winter cover crops. Agricultural workers, however, frequently noted poor growth of this legume, and the need for minor elements was suggested. In 1943 and 1944, borax tests with Austrian winter peas were put out at 12 locations, 10 of which were conducted cooperatively with farmers. Table I gives the average results from these tests and from more limited trials with blue lupine and several other legumes.

Although some small increases in green weight were recorded, the differences are not considered significant, and without exception Austrian winter peas and blue lupine were not benefited by the addition of borax. Except for one test on Madison clay loam near Auburn, these tests were located on sandy soils where, in general, response to borax was obtained with bur clover and alfalfa.

Single tests with soybeans, alyce clover, peanuts, and sericea showed that these crops failed to benefit from borax on a soil that was severely deficient in boron for alfalfa and crimson clover.

It should be emphasized that, although several of the crops listed were tested at a limited number of locations, each crop was tested on one or more soils extremely low in readily soluble boron. This would indicate that the crops classified as nonresponding have extremely low boron requirements for normal vegetative growth. There is still the possibility that the seed yields of some of these legumes listed as nonresponding may be increased by the application of borax.

Amounts of Boron Needed

In the Alabama experiments, which were conducted on soils ranging in texture from loamy sands to clay loams, an application of 20 pounds of borax per acre produced maximum yields of alfalfa for three years without additional applications (Table II). In one experiment on Hartsells fine sandy loam, 15 pounds of borax per acre applied every other year produced about as much alfalfa as double the rate. Two tests on Norfolk loamy sand showed that 20 pounds of borax per acre at seeding provided adequate boron for at least two years, and no boron deficiency symptoms were observed the third year.

The need for accurate information on rates of application of borax was clearly shown by a survey of the recommendations of various states, which was made by Purvis (32) in 1939. The survey showed a range of several hundred per cent in the amount of boron recommended for every crop for which boron was advocated. The recommendations for alfalfa ranged from 10 to 40 pounds of borax per acre.

Recent reports show a wide range in amounts of boron recommended. Bouquet (5) advocated 50 pounds of borax per acre broadcast or 20 to 50 pounds in the row for truck crops. On the other hand, Brown, Munsell, and King (7) reported that 20 pounds of borax per acre prevented deficiency symptoms on alfalfa seven years after application. The tremendous variation that exists in the boron-fixing capacity of different soils was excellently dem-

TABLE III.—WATER-SOLUBLE BORON IN SOILS AND BORON CONTENT OF PLANTS GROWN THEREON.

Alfalfa		Bur clover		Crimson clover	
B in plants, ppm	B in soil, ppm	B in plants, ppm	B in soil, ppm	B in plants, ppm	B in soil, ppm
Untreated areas					
5.3	0.05	5.9	0.22*	11.6	0.13*
4.9	0.08	5.9	0.13*	9.7	0.05
4.3	0.08	4.8	0.11*	5.6	0.03
2.6	0.09	4.1	0.10	5.0	0.13
		4.1	0.03	4.0	0.05
		4.0	0.03		
		3.9	0.05		
		3.5	0.03		
		3.3	0.05		
		2.5	0.09		
Borax-treated areas					
32.0	0.21	24.8	0.38	20.6	0.12
30.0	0.21	19.3	0.15	14.6	0.34
21.5	0.14	17.1	0.29	12.6	0.14
13.5	0.10	15.3	0.15	11.5	0.19
12.5	0.15	14.4	0.06	8.6	0.06
12.3	0.07	13.4	0.19		
11.8	0.13	13.0	0.15		
11.0	0.33	10.8	0.34		
10.5	0.14	10.3	0.14		
9.9	0.11	8.8	0.06		
7.3	0.08				
6.3	0.07				
5.6	0.07				

* The only locations where no response to borax was obtained.

onstrated by Purvis and Hanna (31). In greenhouse tests these workers compared the effects of borax on snap beans grown on a New Hampshire podzol and on a red and yellow podzolic soil from the Piedmont Region of South Carolina (Cecil sandy loam). A 50-pound-per-acre application of borax on the New Hampshire podzol (exchange capacity, 15.2 m. e.) failed to injure the bean crop, while 10 pounds per acre reduced the growth nearly 50 per cent on the Cecil soil (exchange capacity, 4.1 m. e.).

Hutcheson and Cocke (15) reported that 10 pounds of borax per acre on alfalfa at seeding increased yields for two years on a sandy loam in eastern Virginia. In another experiment with rates of borax application, these investigators reported maximum yields from 20 pounds per acre. New Jersey workers (34) recommend for a two-year duration 10 pounds of borax per acre for alfalfa on coarse soils and 20 pounds on fine-textured soils. Washko (36) stated that 20 pounds of borax per acre on alfalfa in Tennessee would "probably be effective as long as the stand lasts." Powers (29) recommended 30 pounds of borax per acre, but reported control of deficiency symptoms from

10 pounds and injury from 40 pounds. He noted a residual effect of borax on alfalfa from two to three years after application.

Some attempts (34) have been made to interpret greenhouse results as indicative of boron needs in the field. Reports by Cook (9), Purvis and Hanna (31), Naftel (26), and greenhouse tests conducted by the writer showed that much smaller amounts of borax are needed for normal growth in pot culture than are used customarily in the field—the exact opposite of greenhouse requirements for nitrogen, phosphorus, and potassium. Although smaller amounts of borax are needed in greenhouse cultures for normal growth, plants generally take up larger amounts of boron than the same species absorb under field conditions. Calculations which are based on uptake of boron by plants in pot cultures where luxury consumption has not been controlled obviously would not be reliable for determining the amounts of borax needed in the field.

While the cost of annual applications of borax or heavier rates applied less frequently would be insignificant, the advisability of using heavier applications of borax than are actually needed is open to question until more is known about the residual effects on other crops.

Critical Levels of Boron in Soils and Plants for Various Legumes

Bur clover was grown on soils with a wide range in water-soluble boron [1] content (0.03 to 0.22 ppm) and responded to a light application of borax by an average increase in yield of 104 per cent (Table I). When grown on soils with water-soluble boron contents ranging from 0.03 to 0.13 ppm B, crimson clover seed production was increased more consistently by boron application than any of the legumes tested. Austrian winter peas and blue lupine were not benefited by boron applications, although grown on soils of low available boron content (0.06 ppm water-soluble boron).

The data in Table III and Fig. 4 show the relationship between water-soluble boron in the soil and boron content of alfalfa, bur clover, and crimson clover plants. There is only a fair correlation between the boron content of the plants and water-soluble boron in the soil when these values approach the critical levels for normal plant growth.

Water-soluble boron in the soil, however, does show some promise for selecting untreated areas where response to borax can be expected. The three areas where no response to borax was obtained with bur clover were the only soils with more than 0.10 ppm water-soluble boron (Table III). Likewise, with one exception, all of the tests with crimson clover showed response to borax where the soil contained less than 0.10 ppm boron.

Critical levels of water-soluble boron in soils, below which the need for additions of boron is indicated for alfalfa, have ranged from 0.35 ppm boron as suggested by Reeve, Prince, and Bear (34) for New Jersey, and Dawson and Gustafson (11) for New York, to 1.00 ppm boron reported by Dregne and Powers (12) for soils of the Willamette Valley. Berger and Truog (3), however, reported 15 per cent black heart disease of table beets where the soil contained 1.45 ppm water-soluble boron.

Alfalfa, bur clover, or crimson clover grown on untreated soils contained less than 6.0 ppm boron in nearly every case where response to borax was obtained (Fig. 4). In 82 per cent of the cases these plants contained more than 10 ppm boron where borax had been applied within three years of the time of sampling.

The following tabulation shows the range in critical values for the boron

(*Turn to page* 40)

[1] Water-soluble boron was extracted from the soil by a modified Berger-Truog procedure (2). Boron in soil and plant extracts was determined by the tumeric procedure as outlined by Naftel (25).

Fig. 1. First irrigation system installed on pecans in the South. Placed in operation fall of 1947 on L. R. Barber & Son farm in Colquitt County, Georgia.

The Development of Irrigation in Georgia

By Everett H. Davis

Irrigation Engineer, Georgia Agricultural Extension Service, Athens, Georgia

IRRIGATION is hitting its stride in Georgia, progressing hand in hand with her State-wide diversification program. Prior to 1945 there were approximately 35 farmers operating irrigation systems in the State, the larger ones growing mainly vegetable plants for early shipment to northern vegetable producers. By early 1948 nearly 150 growers were producing a wide variety of crops under irrigation on over 2,500 acres of land.

This development is going on in all sections of Georgia, a state having 50 inches or more annual rainfall. Besides vegetable plants a wide variety of truck crops, corn, pastures, tobacco, tobacco plants, berries, Irish potatoes, pecans, and flower bulbs are being grown profitably with irrigation. Supplemental irrigation provides the missing link which enables growers to produce quality produce during periods when rainfall is negligible and the markets are most favorable. Drought charts based on U. S. Weather Bureau records prove conclusively that damaging dry periods occur sometime during the growing season *every* year.

A few inches of irrigation water to tide growers over these dry periods mean heavier per-acre production and higher quality produce. No better illustration comes to mind than the Augusta

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strawberry grower who, during a long, hot, dry spell last spring, was selling berries on the market as big as a swollen thumb at 60 cents a quart while other producers had long dropped out or were offering berries not much larger than shelled peas. That grower practically paid for his irrigation system during the first dry period that came along. Some processing plants are recognizing the value of irrigation in the production of high quality crops, particularly strawberries, and in 1947 began a program of contracting with growers for their entire output of berries. The frozen food industry can add considerably to the income of Georgia farmers but, at present, the greater percentage of frozen foods sold in the State is grown and processed outside the State. Consequently, the producer and processor profits are not realized by Georgians in this growing industry now representing about ten million dollars in the State. Frozen foods are more palatable and nutritious than those preserved by other methods and Georgia farmers can, with modern machinery and irrigation equipment, produce as good quality produce as anyone else.

Irrigation systems are commonly referred to by many growers as "the best crop insurance I ever had." As a leading Irish potato grower near Savannah put it, "I haven't needed irrigation for the past two seasons but it paid for itself many times over when I did need it and furthermore it's not for sale either."

A large majority of the irrigation systems in Georgia are of the sprinkler type. Water can be applied more efficiently on most soil types by some method of sprinkler irrigation. Less labor is required by this method and water can be handled with a greater degree of ease and efficiency by inexperienced farm labor.

Chief advantages of sprinkler irrigation over furrow and flood methods are:

TYPICAL DROUGHT RECORD—MIDDLE GEORGIA[1]

FREQUENCY OF DROUGHT PERIODS, 14 DAYS OR MORE DURATION, DURING GROWING SEASON—MARCH TO NOVEMBER 15

Lengths of Drought Periods—Days

Year	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total No. of days of drought each growing season
1929		16					17	19		52
1930	14		14	17		21	30	18 18		132
1931		15	18	21	19		15	20	15	123
1932			20	15						35
1933			14		16		21			51
1934		15					15	20	15	65
1935			19			16	18	20		73
1936		20	31	16		16	14			47
1937	14		16				19			49
1938			18			18	23	20		79
1939	20			24	16		18	31		109
1940			26		24		23	21		94
1941		14	20				25	17	14	90
1942		25		18	14		19	19		95
1943				14	16		18	31		79
1944		15	31				15		15	76
1945	15			15				15		45
1946					17	14				31
1947		15	17	27						59

[1] From records of Weather Bureau as recorded at Griffin, Georgia.

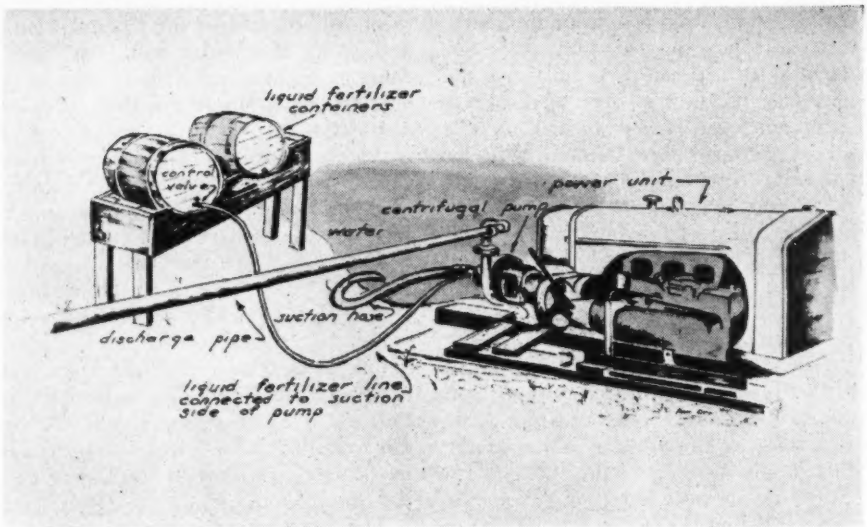

Fig. 2. Introducing liquid fertilizer into the irrigation system is simple and inexpensive. This is the newest of developments in Georgia's Irrigation Program.

(1) It requires less water to accomplish the desired results; (2) inexperienced labor can handle the water satisfactorily and with less amount of work; (3) no leveling of land is necessary which means fertility is not lost due to moving topsoil; (4) it is not necessary to construct and maintain supply ditches; (5) soils do not form a heavy crust; (6) soluble fertilizers can be applied through the sprinklers, thus providing an additional saving in labor; and (7) rate of application of water can be easily controlled to prevent over-irrigation and soil erosion.

The portable revolving sprinkler system is the type most commonly used and is well adapted to all types of crops. Revolving sprinklers, when attached to length of light-weight portable pipe, can be moved from one position to another from a main supply line until the field is completely irrigated. The pipes, both supply and laterals, are equipped with self-sealing, quick-acting couplers, making it possible to move several lengths of pipe from one setting to another in a matter of minutes. The sprinklers usually operate at pressures ranging from 25 to 60 pounds, depending largely upon local conditions and the farmer's personal choice.

Revolving sprinklers in the low-pressure class, 3 to 15 pounds, have been developed recently and tests conducted by the Extension Service indicate that they are playing an important part in low-cost irrigation of tobacco beds, orchards, and truck crops. These sprinklers are particularly useful in irrigating fertile plots of land, located below farm ponds, by gravity flow. A pond with its water surface not less than 12 feet higher than land to be irrigated will furnish enough pressure to satisfactorily operate the low-pressure sprinklers. Pressures developed by flowing artesian wells depend principally on elevation and construction of the wells but range mainly from 3 pounds to 8 pounds per square inch. In order that this water might be put to more beneficial use, since most of it is now being wasted, the development of these low-pressure sprinklers is significant. These single-nozzle sprinklers operate smoothly and distribute water satisfactorily within the range of pressures developed by flowing artesian wells.

What is believed to be the first

sprinkler irrigation system in the Southeast, and possibly the United States, wherein an artesian well furnishes the necessary pressure to operate revolving sprinklers, was demonstrated on the J. L. Clegg farm near Alamo in Wheeler County. Tobacco plants and truck crops were irrigated in 1947.

In the areas of flowing artesian wells the soil is of the sandy loam type and the land is undulating, making sprinkling the most practical and efficient type of irrigation.

Growers will make increasing use of artesian water for irrigation purposes and are becoming more and more conscious of the importance of conserving this supply of which 45,000,000 gallons daily are now wasted, according to State and Federal geologists. If 50 per cent of this daily quantity was utilized for irrigation of crops, over 2,100 acres of land could be irrigated with this modern sprinkler equipment. State and county officials are expected eventually to take appropriate action to have land-owners cap or restrict the flow of unchecked wells as a means of conserving the underground artesian flow.

Areas of artesian flow occur in southwest Georgia, in the river valleys of the northern part of the Coastal Plain, and along the entire east coast area. Most of the flowing wells to date have been drilled in an area within 30 miles of the seacoast.

Another type of sprinkler system, called perforated-pipe system, consists of light gauge portable quick-coupler pipe having a set pattern of small holes drilled along the top side to give a spread of water in strips ranging from 25 to 55 feet wide, depending upon operating pressures (6 to 20 pounds). This type of system is lower in first cost than revolving sprinklers but its use is limited to low-growing crops and on sandy loam type of soils. The system is particularly well suited to pasture and hay production.

The heart of an irrigation system is the water supply. Numerous natural streams, large and small, flow the year-round in all major agricultural areas. Water can be diverted from many streams by ditches located at higher elevations than the irrigated land in many sections of the Piedmont and Mountain regions of the State. These gravity-type irrigation systems are inexpensive to install and require little cash outlay for maintenance. With

Fig. 3. On four acres of irrigated land on this farm in south Georgia, 1,500 dozen bunches of collards were cut. A crop of mustard greens followed the collards.

Fig. 4. Long range sprinklers cover from two to three acres per setting. Distribution of water is uniform. Cattlemen are interested in this development for pasture and hay production.

wood plentiful in these regions, diversion dams built of timber and plank can be easily and economically installed as a means of diverting portions of the stream flow into the irrigation supply ditch.

The size of the supply ditch leading to the field will depend largely upon the acreage to be irrigated. For example, an irrigation ditch approximately 14 inches wide with a water depth of 6 inches and laid out on a grade of 6 inches per 100 feet will carry 1.6 cubic feet of water per second or 720 gallons per minute. With level or gently sloping land and a soil containing very little sand, this would be enough water to irrigate 50 to 60 acres by surface methods. If deep sandy soils are involved or extremely long ditches are required, the irrigated acreage would be substantially reduced.

Many farm ponds are dependable sources of water for small irrigation projects and are now being constructed as such more than for the purpose of fish propagation. Care should be exercised in selecting the dam site and the material used in making the fill. In cases where a considerable amount of sand or porous material is mixed in the soil, the addition of colloidal clay, known commercially as Bentonite, to the soil in the center section of the dam and in a strip along the bottom of the fill usually aids in reducing seepage losses. Ponds not only furnish water for irrigation pumping projects, but can serve sprinkler systems by gravity when situated at elevations 12 feet or more above the land to be irrigated. Irrigation pipe is easily connected to drain pipe in the dam by use of an adapter unit.

Deep wells are being drilled for irrigation purposes in localities where perennial streams or natural lakes do not exist and where suitable ponds can not be constructed for storage of water. Drilled wells of the size suitable for irrigation purposes are costly to install and the subsequent deep well pumping equipment is likewise very expensive. These types of irrigation systems deserve careful consideration and a thorough study of crops to be grown and availability of suitable markets before construction work of any kind gets under way. Only reliable well-drilling contractors should be employed to drill irrigation wells. A few deep well irrigation systems are in operation in

Fig. 5. Flowing artesian well furnishes enough pressure to operate this sprinkler system on Clegg Brothers' farm in Wheeler County. Late fall vegetables and tobacco plants are being irrigated.

Georgia with successful results being obtained in the production of high-quality specialty crops where ready markets are available. Depths to which wells must be drilled to tap the artesian supply vary in different sections of the State and the height to which water rises in wells is directly related to the elevation of the land above sea level. The State Department of Geology, in cooperation with the Geological Survey, has valuable information concerning deep wells, their installation, productivity, and testing.

Some of Georgia's "first's" deserve mention. W. H. Warwick and John Deen, south Georgia tobacco growers, were the first to sprinkle irrigate flue-cured tobacco in Georgia, possibly in the entire South. Warwick pulled a late crop of tobacco through with irrigation which otherwise would have failed, while Deen made two applications of water during critical periods of growth and produced 500 pounds more tobacco per acre than on an adjoining field where water was not applied. Deen's increase of $274 per acre, due to irrigation, enabled him to nearly pay for his portable revolving sprinkler system the first season of operation. One of the early irrigators of tobacco, however, is John Lanier of Candler County who furrow irrigates his crop with successful results and increased returns. O. O. Walker, Coffee County, located his tobacco plant beds on higher ground, irrigated them, produced $1,400 worth of plants on 700 yards of beds, and had sufficient plants for setting out his own 5-acre tobacco allotment. By locating plant beds on higher land and irrigating them, less trouble is experienced with blue mold and mole crickets. Irrigation of tobacco plants enables a deeper root system to develop, thus reducing the damage from crickets that work close to the surface.

Watson Ursy, McDuffie County, utilizes water from a 6-acre pond in irrigating 30 acres of pasture for his beef cattle. Water from each end of the pond dam is turned into supply ditches which carry it to contour ditches in the pasture. The pasture is irrigated by letting the water overflow these ditches along their entire length. Ursy has a mixture of Dallis and carpet grass, lespedeza and white Dutch clover on his irrigated pasture. This 30 acres of pasture supports 60 beef cattle, 100 hogs, and 3 horses.

The Dyar Brothers in Greene County substantiated 1946 results by producing from 1½ to 2½ gallons more milk per cow per day on irrigated pastures during drought periods.

A portable sprinkler system was installed on the Tyson Griffin farm in Whitfield County in 1947 to demonstrate the value of irrigating fall-sown winter grazing pastures. The demonstration is an attempt to prove that, "by seeding winter pasture in August, and irrigating it, cattlemen can have grazing in September." The demonstration in Whitfield County will also point out the value of irrigation on a permanent pasture of ladino clover and fescue. The project is a cooperative set up involving TVA, Georgia Power Company, and the Georgia Agricultural Extension Service.

R. K. Whittier in Fulton County fertilized his 40 acres of corn by spraying liquid nitrogen through his sprinkler irrigation system. With the close cooperation of a fertilizer firm in Atlanta, Whittier was able to haul the nitrogen solution in 55 gallon barrels to his pumping unit where it was drawn into the irrigation system, by the pump, simultaneously with water from the creek. The solution ran 32 per cent available nitrogen and he applied 200 pounds per acre. The solution cost him $60 per ton. He produced $174 worth of corn per acre.

L. R. Barber and son Robert, Colquitt County, are pioneers in the field of pecan irrigation having irrigated 35 acres of nuts in 1947 with the heaviest yield ever. They have high hopes of producing reasonably heavy crops every year with irrigation instead of alternately heavy and light productive years. They are pioneering in the use of liquid fertilizers (complete fertilizers) and plan to run trials on tobacco, cabbage, and corn in connection with their irrigation system this year. They believe irrigation will be of much value in the fall by assuring good stands of cover crops during the fall droughts.

Irrigation installation costs vary widely according to the type of system and local conditions but will range from $25 per acre for gravity surface systems to $125 per acre for portable revolving sprinkler systems which involve pumping units. Annual costs will vary with

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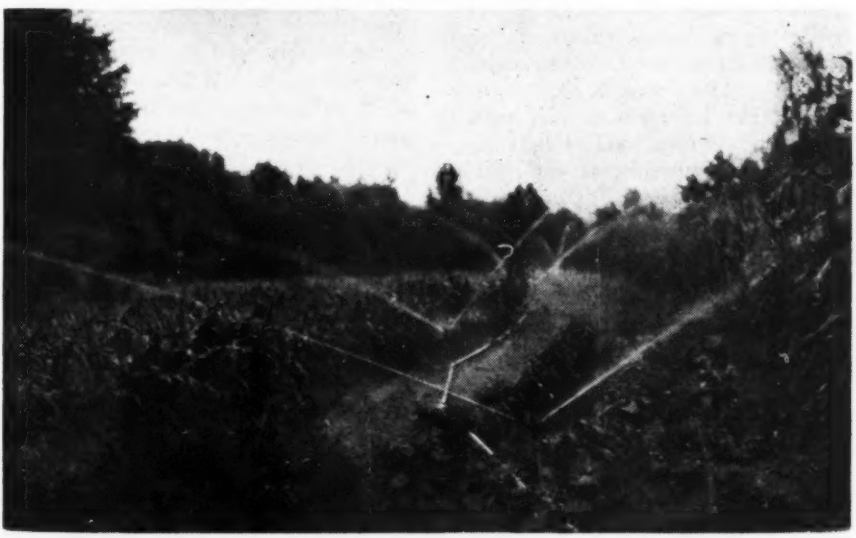


Fig. 6. Successive crops can be grown under irrigation. Here early and late roasting ears are being irrigated during dry weather.

The Chemical Composition of Agricultural Potash Salts

By J. W. Turrentine

Washington, D. C.

IN 1934, the writer published an article [1] on the above subject which he justified as "in response to current demand for more detailed information concerning the composition of fertilizer potash salts." On the basis of frequent current inquiry, that demand seems to be resurgent and is offered again as the excuse for reviewing the subject after the lapse of 14 years.

While the intervening years have witnessed drastic changes in the trade aspects of potash salts, there have appeared only minor changes in their chemical composition. In 1934, of the 264,000 tons K_2O sold in American agriculture, some 150,000 tons K_2O, or 57%, were imported from foreign sources, principally Germany and France, with lesser quantities from Spain and Palestine. Domestic sources supplied 114,000 tons K_2O. During 1947, of the 1,690,000 tons of potash salts, equivalent to 898,000 tons K_2O delivered for agricultural use within the United States, imports from Europe (principally from France) amounted to only 3% of the total, the balance of 97% being of domestic origin.

This total of domestic salts delivered during 1947 was constituted as given in Table I.

Thus it is seen that while the lower grades of salts amount to considerable tonnages, most of the agricultural potash is delivered in the preferred form of the highly refined "60% muriate" grade. The reason is obvious and impelling; namely, that on the delivered basis it is the cheapest per unit K_2O, a consideration that probably vastly outweighs the theoretical value that may be assigned the minute content of the "trace elements" present in the less highly refined salts.

Even 14 years ago this interest in minor impurities or incidental constituents was active, but now it has grown to include a much larger list of elements that have been found to have important functions in plant metabolism. Those elements frequently mentioned are manganese, zinc, and copper. This has led to a continuing search for occurrences of them in fertilizer raw materials.

Accordingly, and in response to inquiry resulting from this, in the following tabulations of analytical data an effort is being made to present informa-

TABLE I.—DELIVERIES OF AGRICULTURAL POTASH SALTS, UNITED STATES, CALENDAR YEAR 1947.

Type	Salts Tons	Equivalent K_2O Tons
60% Muriate	1,170,253	714,389
50% Muriate	134,617	67,714
Potassium Sulfate and Sulfate of Potash-Magnesia	206,346	71,044
"Manure" Salts	179,112	45,003
Total	1,690,328	898,150

[1] "Composition of Potash Fertilizer Salts for Sale on the American Market," Ind. Eng. Chem., 26, 1224 (1934).

tion on both the major and minor constituents of the fertilizer potash salts now being used in such large tonnages in American agriculture. The data have been supplied through the courtesy and cooperation of the potash producers. Their names and the source or raw materials from which their products are derived are identified in the following Tables.

From the several tabulations of analytical data that follow, described as "typical" or "representative," it is obvious that they are not to be confused with specifications for contract purposes since some variation between individual car lots is to be expected. It is hoped, however, that they will provide the answer as to the nature of and the amounts in which minor constituents may occur.

Potash Company of America. Mine and refinery near Carlsbad, New Mexico. Offices, Carlsbad, New Mexico and 50 Broadway, New York. Raw material, subterranean deposit of sylvinite. Products, 60% muriate of agricultural (standard and granular) and chemical grades, run-of-mine salts, and potassium sulfate. Typical analyses of the chloride and sulfate products, agricultural grades, are given in the following Tables II and III.

TABLE II.—TYPICAL ANALYSES OF POTASSIUM CHLORIDE PRODUCTS 60% MURIATE

Constituent	Standard	Granular	Run-of-mine Salts
K_2O	61.00	61.00	25.00
KCl	96.56	96.56	39.58
Potassium	50.64	50.64	20.75
Sodium	1.10	0.92	22.87
Calcium	0.02	0.02	0.12
Magnesium	0.06	0.12	0.25
Chloride	47.64	47.33	54.08
Sulphate	0.08	0.10	0.65
Bromine, etc.	0.07	0.09	0.03
Water-insoluble	0.35	0.85	1.10
Moisture	0.03	0.03	0.15

TABLE III.—TYPICAL ANALYSIS OF POTASSIUM SULFATE

Constituent	%
K_2O	52.00
K_2SO_4	96.20
Potassium	43.17
Sodium	0.94
Calcium	0.02
Magnesium	0.06
Chloride	1.80
Sulphate	53.65
Bromine, etc.	0.02
Water-insoluble	0.32
Moisture	0.02

American Potash and Chemical Corp. Refinery, Trona (on Searles Lake), Calif. Offices, 3030 West Sixth Street, Los Angeles 54, Calif., and 122 E. 42nd St., New York. Raw material, the saturated brine of complex composition of Searles Lake. Products, 60% muriate and potassium sulfate of agricultural and chemical grades; the sulfate, carbonate, and borate of sodium; boric acid, bromine, and lithium concentrates. Analyses of the agricultural grades of 60% muriate and potassium sulfate are given in Tables IV and V.

TABLE IV.—TYPICAL ANALYSIS OF "60% MURIATE," AGRICULTURAL GRADE

Constituent	*Typical**
K_2O (Minimum)	61.21%
Equiv. KCl (Minimum)	96.90
$Na_2B_4O_7$ (Maximum)	0.42
H_2O	0.09
Na_2CO_3	0.27
NaCl	1.57
Na_2SO_4	0.15
KBr	1.62

* Unweighted average of production analysis for July through December, 1947.

TABLE V.—TYPICAL ANALYSIS OF SULPHATE OF POTASH, AGRICULTURAL GRADE

Constituent	*Typical**
K_2SO_4 (Minimum)	97.30%
K_2O (Minimum)	52.60
NaCl	3.20
Cl (Maximum)	1.94
H_2O	0.04
$Na_2B_4O_7$ (Maximum)	0.06
Na_2CO_3	0.08
Na_2SO_4 (less than)	0.68

* Unweighted average of production analysis for July through December, 1947.

TABLE VI.—APPROXIMATE ANALYSES OF 60% MURIATE (AGRICULTURAL AND CHEMICAL), 50% GRANULAR MURIATE, AND MANURE SALTS (RUN-OF-MINE).

Constituent	60% Muriate (Agr. & Chem. Grades)	50% Muriate Granular	Manure Salts Run-of-mine
Potassium chloride (KCl)	98.70%	79.50%	38.80%
(Potassium Oxide (K_2O))	62.34	50.22	24.50
Sodium chloride (NaCl)	1.07	19.49	58.89
Potassium sulphate (K_2SO_4)	.050	.110	.270
Sodium bromide (NaBr)	.050	.050	.035
Magnesium sulphate ($MgSO_4$)	.050	.190	.570
Calcium sulphate ($CaSO_4$)	.003	.170	.450
Sodium borate ($NaBO_2$)	.004	.006	.025
Clay-Sand-insoluble	.01	.380	.740
Water	.060	.100	.220

United States Potash Company. Mine and refinery, near Carlsbad, New Mexico. Office, 30 Rockefeller Plaza, New York. Raw material, subterranean deposit of sylvinite. Products, 60% muriate (Agricultural and chemical), 50% granular muriate and "manure salts" (run-of-mine). Representative analyses of these three products are given in Table VI above.

Bonneville, Ltd. Refinery, Wendover, Utah. Office, 540 W. 7th Street, Salt Lake City. The sub-surface brines of the Bonneville Flats of Western Utah. Product, high-grade muriate.

TABLE VII.—TYPICAL ANALYSIS OF HIGH-GRADE MURIATE FROM THE BONNEVILLE FLATS, UTAH.

Constituent	%
Insoluble in Water	.03*
KCl	95.85
NaCl	3.03
$MgCl_2$	.22
$CaSO_4$	.49
$MgSO_4$	.32
Fe_2O_3	.01
	99.95%

* Composite sample covering 679 cars.

Dow Chemical Company. Refinery and Office, Midland, Mich. Raw material, subterranean brines. Product, high-grade muriate. Complete analysis of this product is given in Table VIII.

TABLE VIII.—COMPLETE ANALYSIS OF HIGH-GRADE POTASSIUM CHLORIDE

Constituent	%
KCl	94.98
H_2O	0.97
H_2O Insoluble	0.046
SiO_2	0.005
R_2O_3	0.022
$CaCl_2$	0.76
$MgCl_2$	1.49
$SrCl_2$	0.10
NaCl	0.74
NH_4Cl	1.02
B	0.015
Mn	0.0001
Cu	0.0001
Fe	0.0018
SO_4	0.013
	100.19
Spectroscopic	
Al	Less than .0001
Cs	Less than .0005
Cu	.0001
Mn	Less than .0001
Ni	Less than .0001
Pb	Less than .0001
Rb	.047
Sn	Less than .001

International Minerals and Chemical Corporation. Mine and refinery near Carlsbad, New Mexico. Raw materials, subterranean deposits of sylvinite* (for muriate) and langbeinite** (for sulfates). Products, 60%

* Sylvinite, a natural mixture of potassium and sodium chlorides in varying ratios.

** Langbeinite, a double sulfate of potassium and magnesium of the composition of K_2SO_4. $2MgSO_4$, admixed with sodium chloride in varying ratios.

(*Turn to page* 48)

PICTORIAL

Lettuce from this field will provide many good salads.

Above: Victory wheat blends into the horizon near Grangeville, Idaho.

Below: The Midwest has its long rows of corn and soybeans.

Above: Utah, in her valleys, grows excellent Pascal celery.

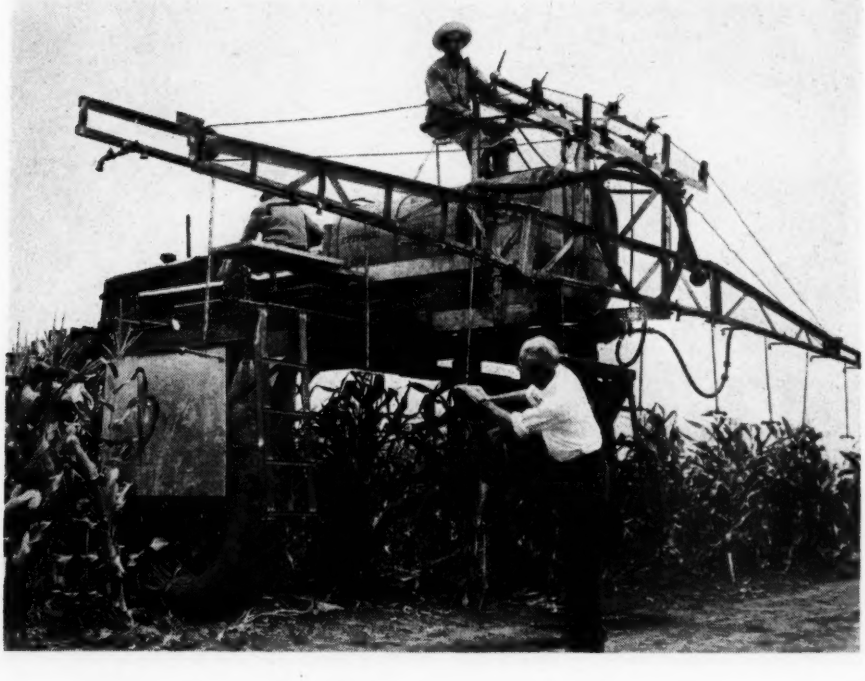
Below: New Jersey truck farms help keep fresh produce on city tables.

Courtesy WJZ Farm News Program

Above: **With sprays and dusts, the all-out war against bugs is under way.**

Below: **This formidable-looking apparatus was devised for controlling the corn borer.**

Courtesy U. S. Rubber Company



The Editors Talk

Shall America Be the Less?

Within recent months we have seen copies of two stimulating addresses full of "land logic" given before conferences on land use and conservation by E. H. Taylor, Associate Editor of *Country Gentleman*. Mr. Taylor is deeply conscious of what land means to a civilization and of the indifference with which Americans have exploited our heritage. Before the Second Annual meeting of the Soil Conservation Society of America held in Omaha, Nebraska, December 4, 1947, he brought out that this country has never had a real land policy and urged the interest of every individual in steps to formulate such a policy if we are to maintain our leadership among nations.

He believes that land is the greatest factor in social and economic development, and he gives as well-considered reasons for that opinion, the following:

1. The bounteousness and variety of our food supply, coming from a comparatively new soil, have given us a vigorous and energetic population throughout our history. Only a people, well-nourished and strong, could have accomplished so much in so short a time. For corroboration and for its significance to our future, he quotes a statement by Dr. George R. Minot of the Harvard School of Medicine: "Initiative, progress, success, and the happiness of a people tend to go hand in hand with an abundance of food and a good diet."

2. An adequate supply of food has been one of the strongest supports of our free political institutions. We are having demonstrated to us, on the present world stage, how precarious is the life of governments where the food supply is inadequate. Hunger is the greatest threat to the stability of any form of government. We have never had to face it here. There have been times when some of our people did not have enough to eat. But those occasions were due to failure of political and social leadership, never to a shortage of food.

3. Our vast industrial development would have been impossible without an abundance of food. Our biggest single industry is the processing and marketing of food, drawing upon innumerable others for materials and equipment. But in another and still more significant way our food resources have facilitated the growth of our complex industrial system. With the single exceptions of the periods following the two world wars, food has not only been plentiful but cheap. This insured a labor force physically capable of doing the work. More important, it left a large margin of earnings to be spent on the products of industry. Over the long record kept by the Department of Agriculture the food basket has accounted for little more than 20 per cent of the average spendable income. Nowhere else in the world has it been possible to satisfy the food needs of a people and have so much of a balance left to be used in raising the

common standard of living. Do the men in industry realize what it will mean if we let our soil resources continue to decline until we become like other lands? Suppose that margin above food requirements drops to 70, to 60, to 50 per cent of the spendable income, what will happen to industry, to labor?

4. The three essentials in war are: Manpower, weapons, and food. A nation without adequate food resources and with its supply lines destroyed is a defeated nation. Never, in all our wars, have we had to worry about an ample supply of food. We have been able to take full care of ourselves and to provision our allies as well. God grant that we may never suffer another war, but if we do we can be sure that a sufficient food supply will be as vital as in the past. A reserve of productivity, stored in the soil, will be as necessary as a stockpile of bombs or other weapons.

5. The products of our soil have been and are now one of the strongest forces for success in our foreign relations. All but forgotten is the fact that for three-quarters of a century they accounted for our favorable balance of trade, enabling us to pay off the capital investments foreigners made here. We know well what they mean now. They are the most powerful arm of our foreign policy. Without them the Marshall Plan or any other effort to stay the march of communism in Europe would be impotent. Our food-producing resources will be no less indispensable to an effective foreign policy in the future. Upon their maintenance depends our strength at home and the ability to produce the surplus supplies needed to back up our foreign policy. A sound land policy does not run counter to our foreign policy; it is its strongest support.

6. The maintenance of our food-producing resources is the very foundation of our national security. Our rival for world leadership is master of the greatest storehouse of natural resources left on earth. But we have ruined one-fifth of our original grant of tillable land and we are using up the remainder faster than it is being restored. All history holds for us the lesson of nations that ignored the waning of their food resources. Their epitaph is written in the Book of Isaiah: "Thy speech shall whisper out of the dust."

> No man is an Iland, intire of it Selfe; Every man is a peece of the Continent, a part of the maine; If a clod be washed away by the sea, Europe is the lesse, as well as if a Promontorie were, as well as if a Mannor of thy friends or of thine owne were; Any man's death diminishes me, because I am involved in Mankinde; And therefore never send to know for whom the bell tolls; It tolls for thee.

Mr. Taylor quotes the above by John Donne, English poet philosopher (1573-1631), in his present-day query—"Shall America Be The Less?"—to arouse to fruitful action America's indifference to the land.

Errata: Unfortunately in Table VII in the article, "Fertilizer Consumption and Supply in the North Central States," by A. L. Mehring which appeared on page 42 of the May 1948 issue of this magazine there were two erroneous figures. In the last listing, "Rest of Country," sixth column, the figure should be 1,327,026 instead of 1,976,312. In the tenth column of this same listing the figure should be 150.6 instead of 224.3.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1923.....	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924.....	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941.....	17.0	26.4	80.7	94.0	75.1	94.4	9.67	47.65	....
1942.....	19.0	36.9	117.0	119.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945.....	21.2	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	28.3	38.2	124.0	219.0	156.0	191.0	17.30	71.40	....
1947									
June.....	34.07	46.0	156.0	249.0	185.0	218.0	16.00	79.60	....
July.....	35.88	48.5	169.0	251.0	201.0	214.0	15.10	79.00	....
August.....	33.15	38.1	161.0	270.0	219.0	210.0	15.30	75.50	....
September...	31.21	40.7	149.0	240.0	240.0	243.0	16.10	75.60	....
October.....	30.65	41.6	150.0	205.0	223.0	266.0	16.80	90.60	....
November....	31.87	40.0	166.0	195.0	219.0	274.0	17.30	89.10	....
December....	34.06	46.9	172.0	204.0	237.0	279.0	18.10	94.80	....
1948									
January.....	33.14	45.9	186.0	217.0	246.0	281.0	18.70	95.10	....
February.....	30.71	38.5	193.0	231.0	192.0	212.0	19.60	88.60	....
March.....	31.77	29.6	196.0	237.0	211.0	221.0	19.70	87.90	....
April.....	34.10	31.2	209.0	240.0	219.0	229.0	19.40	89.40	....
May.....	35.27	40.1	196.0	244.0	216.0	222.0	18.30	90.70	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1923.....	231	190	133	137	129	105	110	183	....
1924.....	185	190	98	170	166	141	107	147	143
1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	93	81	109	74	87	110
1938.....	69	196	80	83	76	64	57	97	88
1939.....	73	154	100	85	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	107	117	107	81	211	129
1942.....	153	369	168	136	143	124	91	202	163
1943.....	160	405	188	232	174	154	125	231	245
1944.....	167	420	214	219	170	160	138	234	212
1945.....	171	366	205	232	198	170	127	227	224
1946.....	228	382	178	249	212	209	146	317	204
1947									
June.....	275	460	224	284	288	247	135	353	215
July.....	289	485	242	286	313	242	127	350	189
August.....	267	381	231	308	341	238	129	335	211
September...	252	407	214	273	374	275	136	335	179
October.....	247	416	214	233	347	301	142	402	238
November....	257	400	238	222	341	310	146	395	272
December....	275	469	247	232	369	316	152	420	294
1948									
January.....	267	459	267	247	383	318	158	422	320
February.....	248	385	277	263	299	240	165	393	320
March.....	256	296	281	270	329	250	166	390	295
April.....	275	312	300	273	341	259	163	396	340
May.....	284	401	281	278	336	251	154	402	262

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947						
June	2.41	1.51	10.94	9.98	12.75	8.26
July	2.41	1.59	12.56	9.98	12.75	8.66
August	2.53	1.60	13.01	9.98	12.75	8.73
September	2.66	1.73	13.65	10.41	12.75	10.72
October	2.66	1.78	15.00	10.85	12.75	13.66
November	2.66	1.78	14.22	11.06	12.75	11.53
December	2.71	1.78	15.98	11.71	12.75	12.81
1948						
January	2.78	1.83	16.22	11.71	12.75	13.28
February	2.78	1.90	15.03	12.15	12.75	12.60
March	2.78	1.90	13.68	12.06	12.75	9.47
April	2.78	1.90	13.87	11.71	12.75	8.35
May	2.78	1.90	13.77	9.54	12.75	7.89
Index Numbers (1910-14 = 100)						
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947						
June	90	53	313	283	378	234
July	90	56	359	283	378	246
August	94	56	372	283	378	248
September	99	61	390	295	378	305
October	99	62	429	307	378	388
November	99	62	406	313	378	328
December	101	62	457	332	378	364
1948						
January	104	64	463	332	378	377
February	104	67	429	344	378	358
March	104	67	391	342	378	269
April	104	67	396	332	378	237
May	104	67	393	270	378	224

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1924	.502	2.31	6.60	.582	860	23.72	
1925	.600	2.44	6.16	.584	860	23.72	
1926	.598	3.20	5.57	.596	854	23.58	.537
1927	.525	3.09	5.50	.646	924	25.55	.586
1928	.580	3.12	5.50	.669	957	26.46	.607
1929	.609	3.18	5.50	.672	962	26.59	.610
1930	.542	3.18	5.50	.681	973	26.92	.618
1931	.485	3.18	5.50	.681	973	26.92	.618
1932	.458	3.18	5.50	.681	963	26.90	.618
1933	.434	3.11	5.50	662	864	25.10	.601
1934	.487	3.14	5.67	.486	751	22.49	.483
1935	.492	3.30	5.69	.415	684	21.44	.444
1936	.476	1.85	5.50	.464	708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367[1]
1942	.600	2.13	6.29	.522	810	25.74	205
1943	.631	2.00	5.93	.522	786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947							
June	.752	2.97	6.60	.330[1]	.589[1]	12.76[1]	.176
July	.760	2.97	6.60	.353	.629	13.63	.188
August	.760	3.08	6.60	.353	.629	13.63	.188
September	.760	3.42	6.60	.353	.629	13.63	.188
October	760	3.42	6.60	.375	.669	14.50	.200
November	.760	3.42	6.60	.375	.669	14.50	.200
December	.760	3.42	6.60	.375	.669	14.50	.200
1948							
January	.760	3.42	6.60	.375	.669	14.50	.200
February	.760	3.42	6.60	.375	.669	14.50	.200
March	.760	3.42	6.60	.375	.669	14.50	.200
April	.760	4.11	6.60	.375	.669	14.50	.200
May	.760	4.61	6.60	.375	.669	14.50	.200

Index Numbers (1910-14 = 100)

1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947							
June	140	82	135	60	62	53	80
July	142	82	135	64	66	56	82
August	142	85	135	64	66	56	82
September	142	95	135	64	66	56	82
October	142	95	135	68	70	60	83
November	142	95	135	68	70	60	83
December	142	95	135	68	70	60	83
1948							
January	142	95	135	68	70	60	83
February	142	95	135	68	70	60	83
March	142	95	135	68	70	60	83
April	142	114	135	68	70	60	83
May	142	128	135	68	70	60	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash[1]
1924.....	143	152	143	103	97	125	94	79
1925.....	156	156	151	112	100	131	109	80
1926.....	146	155	146	119	94	135	112	86
1927.....	142	153	139	116	89	150	100	94
1928.....	151	155	141	121	87	177	108	97
1929.....	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934.....	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937.....	122	131	126	81	50	129	95	75
1938.....	97	123	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	131	127	86	56	130	102	77
1942.....	159	152	144	93	57	161	112	77
1943.....	192	167	151	94	57	160	117	77
1944.....	195	176	152	96	57	174	120	76
1945.....	202	180	154	97	57	175	121	76
1946.....	233	203	177	107	62	240	125	75
1947								
June.....	271	244	215	125	71	343	140	63
July.....	276	244	219	128	72	359	142	67
August....	276	249	223	130	75	364	142	67
September.	286	253	230	133	79	372	142	67
October...	289	254	230	136	80	387	142	71
November.	287	257	231	135	80	380	142	71
December..	301	262	236	138	81	400	142	71
1948								
January...	307	266	242	139	83	403	142	71
February..	279	263	233	139	85	393	142	71
March.....	283	262	233	137	85	379	142	71
April.....	291	264	238	137	85	380	142	71
May.....	289	265	239	137	85	370	142	71

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.**

** **The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Sales of Commercial Fertilizers and of Agricultural Minerals Reported to Date for Quarter Ended March 31, 1948," Bu. of Chem., State Dept. of Agr., Sacramento 14, Calif., FM-164, May 20, 1948.

"State Laboratory Fertilizer, Seed, Lime, and Ice Cream Report, July-December-1947," State Board of Agr., Dover, Del. Vol. 37, No. 4, Dec. 31, 1947.

"Fertilizers, Fertilizer Materials and Rock Phosphate Used in Illinois During 1947," Dept. of Agron., Univ. of Ill., Urbana, Ill., E. E. DeTurk.

"Fertilizers For Field Crops," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Pamph. 112 (Rev.), Feb. 1948.

"Fertilizer Grades and Ratios for Minnesota—Recommended Rates of Application," Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn., Ext. Folder 145, Jan. 1948, C. O. Rost, Paul M. Burson, and E. R. Duncan.

"Fertilizer Tonnage Sales Survey Report for Washington for July 1, 1946 to June 30, 1947," Agr. Exp. Stations, State College of Washington, Pullman, Wash., Sta. Cir. No. 62, Jan. 1948, S. C. Vandecaveye.

"Commercial Fertilizers—1948," State Dept. of Agr., Madison, Wis., Bul. No. 287, Jan.-Feb. 1948, W. B. Griem.

"The Fertilizer Situation for 1947-48," Prod. & Marketing Admin., U. S. D. A., Washington, D. C., Dec. 1947.

Soils

"Our Soil—A Basic Natural Resource," Agr. Exp. Sta., New Haven, Conn., Spec. Bul. Soils I/300, April 9, 1948, C. L. W. Swanson.

"Preliminary Catena Key for the Soils of Connecticut," Agr. Exp. Sta., New Haven, Spec. Bul. Soils III/500, Supplement to Bul. 423, April 20, 1948, C. L. W. Swanson.

"Soil Management in the Upper Peninsula of Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Spec. Bul. 345, Jan. 1948, James Tyson.

"Studies in Soil Nitrogen and Organic Matter Maintenance," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Research Bul. 409, Aug. 1947, M. F. Miller.

"Soil Survey of Rhea County, Tennessee," Bu. of Plant Industry, Soils, and Agr. Engineering, U. S. D. A., Washington, D. C., Series 1940, No. 3, Issued March, 1948, A. H. Hasty, C. A. Mogen, C. B. Beadles, W. C. Sams, and James Tyer.

Crops

"1947 Arkansas Corn Yield Tests," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Report Series No. 8, Jan. 1948, Ben D. McCollum.

"Studies and Observation on the Causes and Control of Chlorosis," Colo. Agr. Exp. Sta., Fort Collins, Colo., Misc. Series Paper No. 357, 1948, Ferris M. Green.

"Twenty-seventh Annual Report, 1946-1947," Ga. Coastal Plain Exp. Sta., Univ. System of Ga., Tifton, Ga., Bul. 44, July 1947.

"Growing Soybeans in Georgia," Agr. Exp. Sta., Experiment, Ga., Press Bul. 597, March 29, 1948, U. R. Gore.

"Annual Report, Research and Investigational Activities for the Fiscal Year Ending June 30, 1947," College of Agr., Univ. of Ga., Athens, Ga., Vol. XLVII, No. 10, June 1947.

"Effects of Variety, Maturity, Nitrogen Fertilization, and Storage on the Ascorbic Acid Content of Turnip Greens," Agr. Exp. Sta., Experiment, Ga., Southern Coop. Series Bul. 6, Sept. 1947, O. A. Sheets, M. Speirs, F. F. Cowart, M. Gieger, L. McWhirter, J. F. Eheart, and R. C. Moore.

"Pointers in Fertilizing Avocados," Agr. Ext. Serv., Univ. of Hawaii, Honolulu 10, T. H., Ext. Cir. No. 52, Rev. May 1948, Z. C. Foster and William Bembower.

"Suggestions for Growing Macadamias," Agr. Ext. Serv., Univ. of Hawaii, Honolulu 10, T. H., Ext. Cir. No. 243, April 1948, William Bembower.

"1947 Illinois Hybrid Corn Tests," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 527, Feb. 1948, J. F. Rundquist, G. H. Dungan, J. H. Bigger, A. L. Lang, Benjamin Koehler, and R. W. Jugenheimer.

"Cooperative Wheat Variety Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 1, A. L. Clapp.

"Cooperative Wheat Variety Tests, 1947, Summary of Protein Analyses," Agr. Exp.

Sta., Manhattan, Kansas, Series C. E. No. 2, A. L. Clapp.

"Cooperative Oat Variety Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 3, A. L. Clapp.

"Cooperative Wheat Fertility Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 4, A. L. Clapp.

"Cooperative Oat Fertility Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 5, A. L. Clapp.

"Cooperative Corn Fertility Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 6, A. L. Clapp, E. A. Clevinger, and L. E. Willoughby

"Cooperative Sorghum Variety Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 7, A. L. Clapp.

"Cooperative Corn Variety Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 8, A. L. Clapp.

"Cooperative Soybean Variety Tests, 1947," Agr. Exp. Sta., Manhattan, Kansas, Series C. E. No. 9, A. L. Clapp.

"Science Serves the Michigan Farmer," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Spec. Bul. 348, March 1948.

"The Behavior of Highbush and Lowbush Blueberry Selections and Their Hybrids Growing on Various Soils Located at Different Levels," Agr. Exp. Sta., Sect. of Hort., Mich. State College, East Lansing, Mich., Tech. Bul. 205, Jan. 1948, Stanley Johnston.

"Raspberry Growing in Michigan," Agr. Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Bul. 287, Feb. 1948, R. E. Loree.

"The Home Vegetable Garden," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 174, Rev. Feb. 1948, Leon C. Snyder.

"Planting the Farmstead Shelter Belt," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 196, Rev. Jan. 1948, Parker Anderson.

"Growing Fruit for Family Use," Agr. Ext. Serv., Univ. of Mo., Columbia, Mo., Cir. 435, Nov. 1947, W. R. Martin, Jr., and H. G. Swartwout.

"Growing and Harvesting the Sweetclover Seed Crop," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 387, Dec. 1947, Samuel Garver and T. A. Kiesselbach.

"Maintaining Cotton Yields Through Fertilizer and Crop Rotation," Agr. Exp. Sta., N. M. College of A. and M. A., State College, N. M., Bul. 340, Oct. 1947, Glen Staten and D. A. Hinkle.

"Sixty-Sixth Annual Report," N. Y. State Agr. Exp. Sta., Geneva, N. Y., 1947.

"Seedbed Preparation for Pastures and Alfalfa," Agr. Ext. Serv., State College Sta., Raleigh, N. C., Ext. Cir. 308, Feb. 1948, S. H. Dobson and R. L. Lovvorn.

"Bunch Grape Culture," Agr. Ext. Serv., State College Sta., Raleigh, N. C., Ext. Cir. 311, Feb. 1948, H. R. Niswonger and M. E. Gardner.

"Producing Bright Cigarette Tobacco in the Old Belt," Agr. Ext. Serv., State College Sta., Raleigh, N. C., Ext. Cir. 314, March 1948.

"Oklahoma Crops and Soils, 1947," Agr. Exp. Sta. Okla, A & M College, Stillwater, Okla., Exp. Sta. Bul. No. B-319, March 1948.

"Science for the Farmer," Agr. Exp. Sta., State College, Pa., Supp. 2 to Bul. 488, 60th Ann. Rpt., March 1948.

"Rhode Island Agriculture on the March!" Agr. Exp. Sta., Kingston, R. I., Unno. Bul., 1948.

"Corn in South Carolina," Clemson Agr. College, Clemson, S. C., Cir. 313, March 1948, H. A. Woodle and W. H. Craven.

"Korean Lespedeza," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Cir. No. 98, Jan. 1948.

"Variety Performance Trials of Oats, Barley, Wheat, Corn, and Soybeans," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. No. 206, Jan. 1948, O. H. Long and S. F. McMurray.

"Research Publications Available," Agr. Exp. Sta., Texas A & M, College Station, Texas, Cir. 119, Feb. 1948, Tad Moses.

"Summer Prolific—A Promising New Tomato for the West Cross Timbers," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1105, Jan. 20, 1948, Tom E. Denman.

"Cotton Variety Test, Brazos River Field Laboratory, College Station, 1943-47," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1108, Feb. 9, 1948, J. E. Roberts and D. T. Killough.

"Cotton Variety Test, Main Station Farm, College Station, 1943-47," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1109, Feb. 9, 1948, J. E. Roberts and D. T. Killough.

"Cotton Variety Tests at the Blackland Station, Temple, 1947," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1110, Feb. 12, 1948, B. D. Hargrove.

"Horticultural Characters of Tomatoes," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 698, Nov. 1947, P. A. Young and J. W. MacArthur.

"Corn Production," Agr. Ext. Serv., Va. Polytechnic Inst., Blacksburg, Va., Ext. Bul. 99, Rev. Jan. 1948.

"1947 Varietal Tests," Agr. Exp. Sta., Blacksburg, Va., Bul. 412, Dec. 1947, C. F. Genter, Edward Shulkcum, C. W. Roane, and M. H. McVickar.

"Help Your Garden Grow for Food, Fun, Freedom, Friendliness," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 120, April 1948.

"Fifty-sixth Annual Report," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Bul. 482, Dec. 1946.

"Rooting Blueberry Cuttings," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Bul. 488, May 1947, C. D. Schwartze and Arthur S. Myhre.

"Grow A Freedom Garden," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 119, Feb. 1948.

"Freedom Gardens," State Dept. of Agr., Charleston, W. Va., Bul. (N. S.) 59, March 1, 1948.

"Asparagus in Wisconsin," Ext. Serv., College of Agr., Univ. of Wis., Madison, Wis., Stencil Cir. 239, (Rev. Jan. 1948), Oct. 1947, O. B. Combs.

"Through Research to Better Farming," Biennial Report for the Period 1944-1946, Agr. Exp. Sta., W. Va. Univ., Morgantown, W. Va., Bul. 330, June 1947.

"Plants Link Soil and People," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 375, March 1948, Henry L. Ahlgren and J. W. Clark.

"How Extension Programs Help, 1946 Report," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 376, July 1947.

"The Oat Situation in Wisconsin," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Spec. Bul., Oct. 1947.

"Report of the Chief of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, 1947," U. S. D. A., Washington, D. C.

"Production of Disease-Free Seed Potatoes," U. S. D. A., Washington, D. C., Cir. No. 764, March 1948, T. P. Dykstra.

"Falling of Wheat Culms Due to Lodging, Buckling, and Breaking," U. S. D. A., Washington, D. C., Cir. No. 767, March 1948, Hurley Fellows.

"Winter Legumes for Green Manure in the Cotton Belt," U. S. D. A., Washington, D. C., Farmers' Bul. No. 1663, Rev. Jan. 1948, Roland McKee and A. D. McNair.

"White Clover," U. S. D. A., Washington, D. C., Leaflet No. 119, Rev. Aug. 1947, E. A. Hollowell.

"Production of Spinach," U. S. D. A., Washington, D. C., Leaflet No. 128, Rev. Jan. 1948, J. H. Beattie.

"Oil Crops in American Farming," U. S. D. A., Washington, D. C., Tech. Bul. No. 940, Nov. 1947, Peter L. Hansen and Ronald L. Mighell.

"Nutritional Qualities of Range Forage Plants in Relation to Grazing With Beef Cattle on the Southern Plains Experimental Range," U. S. D. A., Washington, D. C., Tech. Bul. No. 943, Dec. 1947, D. A. Savage and V. G. Heller.

"Cultural Practices as Related to Incidence of Cotton Root Rot in Texas," U. S. D. A., Washingon, D. C., Tech. Bul. No. 948, Feb. 1948, Howard V. Jordan, James E. Adams, Dalton R. Hooton, Dow D. Porter, Lester M. Blank, Eldon W. Lyle, and C. H. Rogers.

"Distribution of the Varieties and Classes of Wheat in the United States in 1944," U. S. D. A., Washington, D. C., Cir. No. 761, Jan. 1948, J. Allen Clark and K. S. Quisenberry.

"The Dixired, Dixigem and Southland Peaches," U. S. D. A., Washington, D. C., Cir. No. 766, Jan. 1948, John H. Weinberger.

"Report on the Agricultural Experiment Stations, 1947," Office of Exp. Stations, U. S. D. A., Washington, D. C., Issued Jan. 1948.

"The Agricultural Research Center of the United States Department of Agriculture," Agr. Research Admin., U. S. D. A., Washington, D. C., Unno. Spec., Rev. Jan. 1948.

Economics

"Booms, Depressions, and the Farmer," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 376, Feb. 1948, S. V. Ciriacy-Wantrup.

"1948 Wheat, Flax, and Soybean Outlook," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 156, Agr. Outlook Series No. 4, Jan. 1948, D. C. Dvoracek.

"1948 Agricultural Outlook," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 158, Agr. Outlook Series No. 6, Jan. 1948, W. H. Dankers and M. K. Hinds.

"1948 Farm Costs Outlook," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 159, Agr. Outlook Series No. 7, Jan. 1948, J. B. McNulty.

"Recent Changes in Cotton Acreage in Ten Southern States," Agr. Exp. Sta., Miss. State College, State College, Miss., Unno. Bul.

"1948 New York Agricultural Outlook," Agr. Ext. Serv., Cornell Univ., Ithaca, N. Y., Ext. Bul. 736, Jan. 1948.

"The Cost of Producing Milk, Montgomery County, 1944-45," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., Bul. 842, Nov. 1947, L. C. Cunningham.

"Fruits, Postwar Purchases by Consumers," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., A. E. 651, Dec. 1947, M. P. Rasmussen and M. R. Godwin.

"Vegetables, Postwar Purchases by Consumers," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., A. E. 652, Dec. 1947, M. P. Rasmussen and M. R. Godwin.

"The Use and Costs of Tractor Power on Small Farms in Anderson County, South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 368, July 1947, Charles P. Butler and D. E. Crawford.

"Agricultural Outlook for South Carolina—1948," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 309, Jan. 1948.

"Cotton Statistics for Texas," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Cir. No. 117, Sept, 1947, C. A. Bonnen and L. P. Gabbard.

"The Prospective Market Distribution of Washington Apples," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Bul. 491, Sept. 1947, Walter M. Bristol.

"Washington Apple Production Costs for the 1945-46 and 1946-47 Seasons," Agr. Exp. Stations, State College of Wash., Pullman, Wash., Bul. 493, Aug. 1947, W. M. Bristol.

Response . . . of Boron in Soils and Plants

(*From page* 16)

content of alfalfa plants, as reported by various investigators:

McLarty, Wilcox, and Woodbridge (19)—6.9 ppm B, deficient plants.
Berger and Truog (4)—8 ppm B in deficient plants.
Haddock and Vandecaveye (14)—10 ppm B, deficient.
Powers (29)—10 ppm B, yellows.
Dregne and Powers (12)—7.0 to 11.5 ppm B, deficient alfalfa, but also normal plants contained 12 to 22.5 ppm B.
Jordan and Powers (17)—12 ppm B, deficient.
Dunklee and Midgley (13)—15 ppm B, need for boron.
Brown, Munsell, and King (7)—17 ppm B, response to boron. Also 17 ppm B where no response was obtained.
Whetstone, Robinson, and Byers (37)—13 to 17 ppm B, response to boron on Cecil soil and 12 to 19 ppm B where no response was obtained on Huntington soil.
Dawson and Gustafson (11)—20 ppm B, critical level.
Munsell and Brown (23)—23 ppm B in leaves, yellows.

Allowing for borderline cases, it would appear that if the soil contains less than 0.15 ppm water-soluble boron or these plants (alfalfa, crimson and bur clover) contain less than 10 ppm boron, response to borax is indicated.

It should be emphasized that the critical levels of 0.15 ppm water-soluble boron in the soil and 10 ppm boron in alfalfa and bur or crimson clover, which have been derived from the data reported herein, do not necessarily apply either to similar-textured soils of other regions or to fine-textured soils of the same region. The far-reaching effects of exchangeable calcium, exchange capacity, and organic matter content on both boron requirement and tolerance to borax have been demonstrated by other investigators (10, 16, 22, 31, 33).

Tolerance of Certain Legumes to Borax

Early in the course of the field tests on sandy soils, it was found that 15 to 20 pounds of borax per acre broadcast at time of seeding would severely injure the stand of Austrian winter peas, crimson clover, red clover, and white clover if soil moisture was low at time of germination. Figure 5 shows a field that was planted to Austrian winter peas where the stand was almost completely destroyed by the application of 15 pounds of borax broadcast at time of planting. The application of 15 to 20 pounds of borax to crimson clover severely reduced the stand on sandy soils at one or more locations in 1942, 1943, and 1944, even though these same areas were deficient in boron and responded to borax in increased seed yields. The residual boron from a 15-pound-per-acre application to crimson clover was toxic to soybeans the next summer on a loamy sand at Auburn. The clover in this test failed without borax, while soybeans which followed the clover showed a slight reduction in yield on the borax-treated plots from the borax remaining in the soil nine months later.

The observation that applications of borax at time of seeding injured the stand of several legumes led to a study of different methods of applying borax. Some of the results of this test are given in Table IV. Starting one month in advance of seeding, borax (20 pounds per acre) was applied at varying intervals until about three months after seeding. It was found that by delaying the application of borax until the seedlings were established and good soil moisture was present, injury to stands of such legumes as Austrian winter peas, vetch, and crimson clover

was avoided. However, this method was not satisfactory for bur clover on soils severely deficient in boron. As shown in Fig. 1 and mentioned previously, the bur clover seedlings died after germination during dry fall months when the application of borax was delayed. It was concluded that it would be necessary on these soils which are extremely low in boron to apply borax previous to or at time of seeding bur clover. Borax (20 pounds per acre) applied prior to seeding with at least one heavy rain before seeding caused very little injury to any of the plants tested. Neither delayed application nor treatment several weeks before seeding is a very practical method. Therefore, it was concluded that the rate of borax should be kept sufficiently low to avoid injury and the borax applied with the other fertilizer materials, preferably about two weeks in advance of seeding. It is believed that 8 to 10 pounds of borax per acre uniformly distributed broadcast will not injure seriously any of the legumes needing additions of boron. This rate of application will probably provide sufficient boron for the Trifoliums and

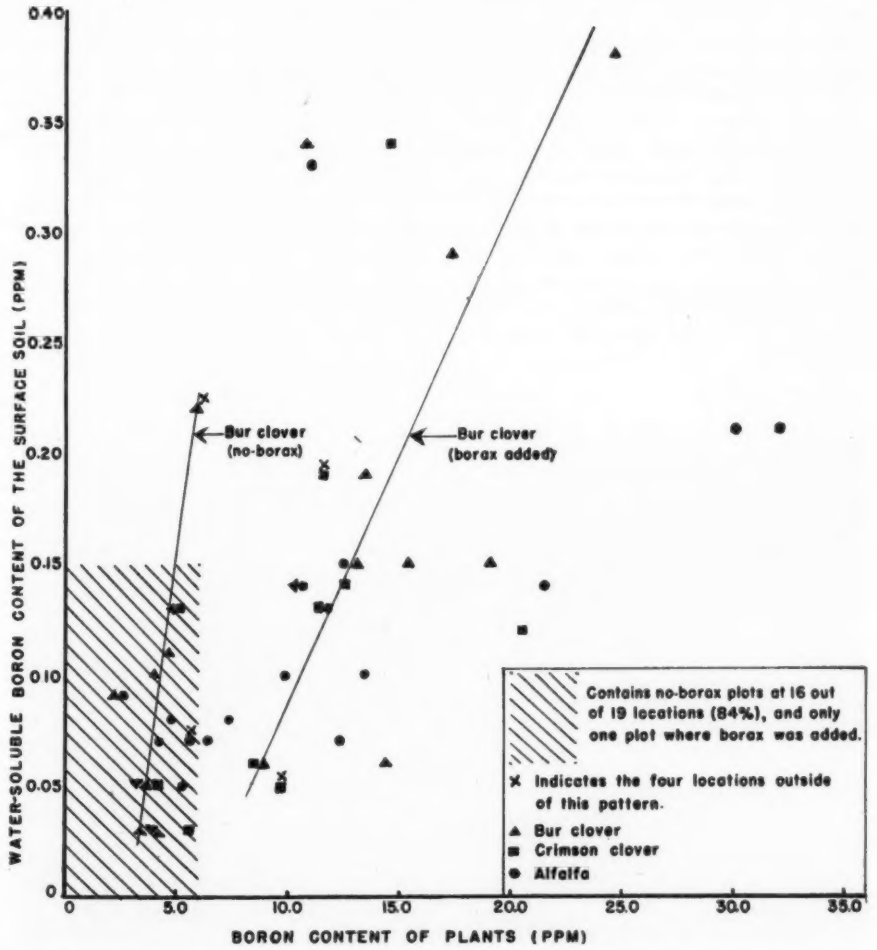


Fig. 4. Relation between boron content of legumes and water-soluble boron in the soil.

vetches that were studied. Bur clover and alfalfa appear much more tolerant and may require slightly heavier applications of borax.

Wallace (35) applied five pounds of borax in the drill row and injured velvet beans; while Purvis and Hanna (31) reduced the yield of snap beans on two sandy loam soils with 10 pounds per acre, regardless of method of applications. Piland, Ireland, and Reisenauer (28) found that 20 pounds of borax per acre reduced the stand and height of soybeans on one North Carolina soil. Nelson and Colwell (27) of the same station reported that the only soil to give response by soybeans was a fine sandy loam with high exchange capacity, which was also well supplied with exchangeable calcium and organic matter. Reeve, Eldrow, and Shive (33), working with solution cultures found that high calcium concentrations intensified boron deficiency at low levels of boron and also decreased boron toxicity at high rates of boron application. High potassium concentrations, on the other hand, favored toxicity of boron at high levels and intensified the deficiency of boron at low levels. The smallest amount of borax which has been found to injure field crops, as reported in the literature, was obtained by Conner and Plice (8) who concluded that it was dangerous to fertilize corn in the row with more than one-half pound of borax per acre. The same investigators reported no injury to corn from 16 pounds of borax when applied broadcast.

Summary

Field tests with borax at 70 crop locations included alfalfa, bur clover, crimson clover, red clover, white clover, Austrian winter peas, blue lupine, vetch, soybeans, alyce clover, peanuts, and sericea. Most of these field experiments were located on coarse-textured soils in central and southern Alabama, areas where difficulty had been experienced in growing some of these legumes. Alfalfa produced on the average 58 per cent (1,807 pounds per acre) more hay where borax was applied, responding on 12 of the 13 fields. Bur clover gave an average increase for borax of 104 per cent and re-

Fig. 5. Loss of stand of Austrian winter peas from 15 lbs. of borax applied broadcast at time of planting on a coarse-textured soil. Photographed in February 1943.

TABLE IV.—EFFECT OF TIME OF APPLYING BORAX ON RESPONSE AND INJURY TO WINTER LEGUMES ON NORFOLK LOAMY SAND

Treatment No.	Time and method of applying borax, 20 lb. per acre	Green manure crops, lb. per green wt.		Monantha vetch for seed, lb. per acre		Degree of toxicity[4]
		A. w. peas [1]	Manganese bur clover [2]	Straw	Seed [3]	
1	No borax	8,377	2,656	3,750	197	.....
2	Borax applied 4 weeks before seeding	7,818	8,281	n.d.[5]	n.d.	3rd
3	Borax applied with other fertilizer at time of seeding	7,725	9,531	n.d.	n.d.	2nd
4	Borax applied ⅓ at seeding time and ⅔ three months later	8,563	7,187	n.d.	n.d.	4th
5	Borax applied one month after seeding (2 weeks after emergence)	6,422	6,250	4,000	341	1st
6	Full rate of borax applied three months after seeding	8,470	4,063	n.d.	n.d.	5th

[1] Austrian winter peas showed severe injury by treatment No. 5 about 3 months after planting. Crop was grazed off twice during winter by livestock and plot differences largely overcome by April when clippings were taken.

[2] Manganese bur clover was practically a failure without borax or where treatment was delayed 3 months after seeding. Seedlings came up to good stand but died during the fall months. (See Fig. 1).

[3] Vetch showed very little or no vegetative response to borax. Treatments No. 1 and 5 were only ones harvested for seed.

[4] Crimson clover and blue lupine were included in these tests. Poor inoculation of crimson clover and winter killing of lupine prevented reliable yield determinations of these crops. Borax had no observable effect on inoculation of clover or stand of lupine, but injured stand of clover where applied as treatments 3 or 5. Rainfall during fall months was determining factor in injury by borax to seedlings of these crops. Ranking of the several crops in December as to their susceptibility to injury by borax: Austrian winter peas> crimson clover> vetch> bur clover = lupine.

[5] Yields were not determined.

sponded on seven of the 10 locations. Crimson clover seed production was increased on all 10 areas where seed yields were recorded, with an average increase of 259 pounds of seed per acre. The group of legumes responding to borax also included vetch for seed, red clover, and white clover.

In 12 tests with Austrian winter peas, borax failed to give significant increases on a single field. Blue lupine, soybeans, alyce clover, peanuts, and sericea did not respond to borax on soils that were highly deficient in boron for alfalfa and crimson clover.

No increases in plant growth were obtained where the untreated soil contained more than 0.15 ppm hot water-soluble boron. In nearly every test untreated alfalfa, crimson clover, and bur clover plants contained less than 6.00 ppm of boron when grown on fields where response to borax was obtained. In 82 per cent of the cases where borax had been added within three years the plants contained more than 10 ppm boron. If these legumes contain less than 10 ppm boron, or the soil contains less than 0.15 ppm hot water-soluble boron, response to additions of borax is indicated on the coarse-textured red and yellow podzolic soils of Alabama. It was pointed out that these critical levels probably do not apply to fine-textured soils of the same region or soils of other regions that have high boron-fixing capacities.

It was concluded that alfalfa, which has been rated as having a high boron requirement, actually needs very small amounts of this trace element when grown on soils with a low calcium supply and low base exchange capacity. Consequently, the boron requirement

of alfalfa is extremely low when grown on the red and yellow podzolic soils of the Southeastern United States. A single application of 20 pounds of borax per acre produced maximum yields of alfalfa for three years on sandy soils low in native boron. In some cases boron deficiency symptoms have been observed on alfalfa plants before any appreciable reduction in hay yields occurred. For this reason the most practical way to supply the boron needs of this crop may be to apply small amounts of borax annually or every other year with other fertilizers.

An application of boron at time of seeding bur clover was essential to securing a stand on two sandy soils and is rated highly important for this crop.

Severe injury to stands of Austrian winter peas, crimson clover, red clover, and white clover was reported on sandy soils from the application of 15 pounds of borax per acre at time of seeding these legumes. Soybeans and sericea also showed low tolerance for borax.

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The Development of Irrigation in Georgia

(*From page* 23)

each individual system, depending upon type of equipment installed, electric power or fuel costs, fertilizer requirements, and cost of labor, but on the average will amount to $20 to $30 per acre.

The 1948 season will find Georgia farmers occupying front-row seats insofar as the latest in irrigation developments are concerned. At least three farmers and one experiment station will be making trial runs with the application of liquid fertilizer through irrigation systems on various crops such as tobacco, tobacco plants, corn, cabbage, collards, and cucumbers. At least three Florida citrus growers are arranging to try out the complete fertilizers, soluble

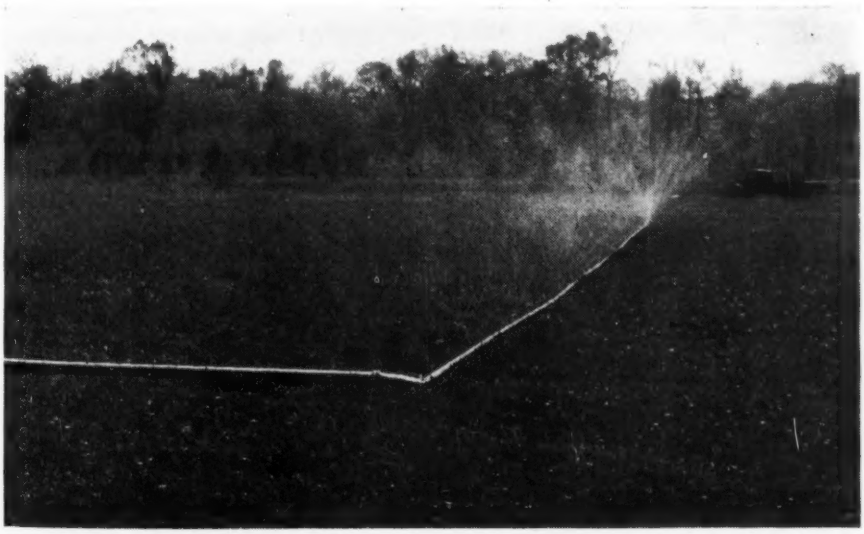


Fig. 7. Perforated-pipe sprinkler system on dairy pasture. Water sprays from 15 to 25 feet on each side of the pipe. System is entirely portable. Dyar Brothers' dairy farm in Greene County, Georgia.

in water, in connection with the irrigation of orange and grapefruit groves.

Livestock people are expressing interest in the recently-developed long range sprinkler which irrigates two to three acres per setting. It might mean low-cost irrigation of pastures and hay crops for the cattlemen.

Community irrigation projects are in the making in Georgia too. The U. S. Army Engineers continue their study of the Altamaha River Basin Project which was determined economically feasible by a New York engineering firm in 1947. Irrigation of nearly 300,000 acres in the basin is considered a major contribution to the practicability of the project. A highly diversified agricultural program is in prospect on some of Georgia's best land situated in the Altamaha basin.

The leadership Georgia has taken in supplemental irrigation and the rapid progress she is now making is due, in large, to the excellent efforts being made by equipment distributors over the State to give farmers proper service. Four companies in Georgia are handling complete lines of irrigation equipment and are able to provide the grower with a system complete from the foot valve to the last sprinkler in the field.

Irrigation research work is now under way at four experiment stations covering the field of vegetable crops, pastures (permanent and temporary), field corn, and certain small fruits. Additional research is sorely needed, and being considered, in the production of peaches, pecans, alfalfa and other field crops, and small fruits.

Applying Fertilizers in Solution

(*From page* 8)

present high price of these materials limits their use.

Many of the liquid fertilizer manufacturers include zinc, manganese, copper, iron, and other minor elements in the mixes. However, the value of this

Fig. 4. California Liquid Fertilizer Company Plant, Pasadena, California.

Fig. 5. Distribution center for Sul-tech (SO_2).

procedure is not now recognized by State authorities.

All liquid fertilizer materials are introduced into irrigation waters by means of gravity flow or under pressure using various metering devices. When the gravity flow method is used, these materials, except those under vapor pressure, are applied directly into head ditches or low weir boxes. When it is necessary to apply these same materials in high standpipes or pressure lines, pressure is developed by using a dry N cylinder or CO_2 cylinder in the system.

Liquid mixed fertilizers and some nitrogen solutions are transported in barrels, drums, and specially constructed tank carts to the irrigation system in the field. Anhydrous ammonia and sulfur dioxide are each carried in steel cylinders under a high vapor pressure. These liquid materials meter out as a gas into the irrigation waters.

Uniform distribution is an important consideration, and various means are employed to insure proper application. For instance, in sandy soils and in heavier soils where long irrigation furrows are encountered, the irrigation period is allowed to proceed for various lengths of time before introducing the fertilizer materials.

To prevent precipitation of insoluble carbonates which might occur in many irrigation waters when anhydrous ammonia is used, a material called rose stone is added in very small amounts simultaneously with the NH_3.

Many of the liquid mixed fertilizers and some of the nitrogen solutions contain synthetic or organic wetting agents or a soil flocculent to increase penetration.

The practice of most of the concerns marketing these materials is to include the service of applying the material in the selling transaction. This has proven a very popular procedure with the grower, relieving him of the operation of applying the fertilizer.

The progress of the last five years with fertilizer materials adapted for distribution through irrigation systems has been the subject of much discussion and conjecture. Unquestionably the method and many of the "liquid" materials are here to stay. At the present time there seems to be but little agronomic information in this field, and the future growth of this segment of the fertilizer industry would be much clearer if development of more data on comparisons of solution fertilizers and dry fertilizers could be accomplished.

The Chemical Composition . . . Potash Salts

(*From page* 26)

muriate, 50% muriate, potassium sulfate and double sulfate of potassium and magnesium ("Sul-Po-Mag"). Representative analyses of these four products are given in Tables IX and X.

TABLE IX.—TYPICAL ANALYSES OF 60% AND 50% MURIATE OF POTASH

Constituent	60% Muriate	50% Muriate
Potassium (K)	50.32	43.24
(K_2O)	60.61	52.08)
Magnesium (Mg)	.16	.21
Sodium (Na)	1.00	6.24
Calcium (Ca)	.10	.10
Chlorine (Cl)	47.00	48.70
Sulphate (SO_4)	.91	.97
Bromine (Br)	.062	.06
Insol. Matter	.35	.35
Moisture	.09	.10
Total	99.992	99.97

TABLE X.—TYPICAL ANALYSES OF POTASSIUM SULPHATE AND SULPHATE OF POTASH-MAGNESIA.

Constituent	Potassium Sulphate %	Sulphate of Potash-Magnesia %
Potassium (K)	41.16	18.51
(K_2SO_4)	91.75	41.25)
Magnesium (Mg)	1.40	11.25
(MgO)	.....	18.65)
Sodium (Na)	.13	.97
Calcium (Ca)	.20	.01
Chlorine (Cl)	2.20	1.74
Sulphate (SO_4)	53.80	67.06
Bromine (Br)	.005	.005
Insol. Matter	1.00	.20
Moisture	.10	.19
Total	99.995	99.935

French Potash & Import Co. Mines and refineries, Alsace, France. New York Office, 51 E. 42nd Street. Raw material, subterranean deposits of sylvinite. Products (imports) 60% muriate.

TABLE XI.—TYPICAL ANALYSIS OF FRENCH 60% MURIATE

Constituent	%
K_2O	61.43
KCl	97.20
NaCl	2.30
$MgCl_2$	Trace
KBr	0.15
Insoluble	0.25
H_2O	0.15

Trace Elements

From the foregoing tables of analyses of the various potash salts being distributed on the American market the incidental impurities or constituents present in greatest amounts can be observed. Among them are elements recognized as of crop nutritive value, such as calcium, magnesium, and boron, but in amounts too small to be significant in view of the fact that crop requirements call for much larger quantities than those represented by the applications incidental to potash use. An exception, of course, is the product, sulfate of potash-magnesia, which is designed as a carrier of both magnesium and potassium.

Not shown except in Table VIII, are the so-called "trace elements," such as copper, manganese, zinc, and others which have been found essential to properly balanced crop nutrition and which occasionally are deficient in certain soils for that proper balance. The amounts required are relatively so minute as to add possible significance to even the small amounts sometimes found to be present in the major plant-food carriers. From the analyses herein presented it is obvious that these elements when present are properly described as trace elements.

Their presence is to be anticipated when the fact is recalled that subter-

ranean potash deposits are the result of the evaporation of large bodies of ocean brine, bringing about saturation with respect to its major constituents and their crystallization, carrying down with them inclusions, as impurities, some of all of the constituents of the highly concentrated brine from which crystallized.

This has been confirmed by the spectographic analysis of crude sylvinite of French origin revealing the presence of 20 metals in addition to those hereinbefore tabulated.* Similar methods applied in the analysis of the potash salts derived from the New Mexico sylvinite deposits reveal the presence of manganese, copper, iron, boron, and 14 other metals in amounts from 0.1% down to merest traces. It has been noted that the same applies in general to the potassium chloride derived from the natural brines of Michigan (Table VIII).

However valuable these trace elements may be where needed in crop nutrition, it may be remarked that the task undertaken by the potash producers is to deliver potash salts to the farmer in their cheapest form. To that end concentration is essential to reduce delivery costs. That obvious fact may be emphasized by the pertinent statement that for a given freight charge per ton of potash salts, the delivery charge per unit K_2O (which is the unit of value) is lower the higher the concentration. To illustrate, at a freight charge of $10 per ton of salts the charge is $.17 per unit K_2O in 60% muriate as compared to $.40 per unit in 25% run-of-mine salts. Hence, refining to reduce the major impurities is essential if the farmer is to get his potash at the lowest possible cost. The same principle, of course, applies to all the major plant-food carriers.

In the case of the run-of-mine potash salts (Tables II and VI) which are essentially crude sylvinite, it is seen that the major constituent is sodium chloride. Evidence is reported that in soils very deficient in potash, sodium may function to some small degree as a substitute for potassium. Until its value as such a substitute is assigned in concrete terms, its indiscriminate use in agriculture cannot be justified if its cost to the farmer is considered.

If, in the process of refining, some of these elements of possible value are reduced in concentration, the farmer still gains an advantage in concrete terms of dollars saved per ton of potash to be contrasted with a theoretical and wholly speculative loss in the elimination of trace elements which his crops may or may not need. In other words, reliance on incidental impurities as sources of crop nutrients is a reversion to the now discredited "shotgun" methods of fertilization which if pursued will lead us away from reliance on diagnostic techniques for determining the nutritional status of soils and crops now developed to a science of the greatest value and widespread usefulness.

* Boret, V.—Elements Accessoires de la Sylvinite de l'Alsace. Institute des Rescherches Agronomiques, pp. 177-178, Rapport de 1929.

Centenary

(*From page* 5)

clear evenings on bivouac, thinking if his mother could by chance be looking at the same full moon he saw above the pines of Arkansas.

Then there were interludes of homecoming reunions, job-hunting by returning soldiers, and at last a few long years of rough and ready adventure in the big woods logging camps, along with rafting lumber abreast the same river he had traveled in the army. He could describe exactly how they built

and lashed those valuable lumber piles as floating rafts that had to conquer many a whirling rapids and survive sudden storms. I have since seen photos of the brash and rowdy rivermen who were his comrades of commerce; and I treasure one picture of Father standing with four other workmen on a shingle mill roof, to make sure that they got properly "took" along with the other scenery.

BUT there are also afloat stray bits of information which do not depend on my memory or the words of my parents. Let's mention some.

My State's constitutional convention convened in December 1847 and continued in session through February 1848. This was the year when the Whigs put up General Zachary Taylor for president, despite the fact that he had never cast a vote in his life. Scanning a report of the convention it is noted that there were 18 Whigs and 42 men who were labeled "Locofocos." These rebellious ones were really left-wingers of the Democratic party, but the local columnists of the day said that "from the great amount of talent and legislative capacity which is brought together at this convention we have the fullest confidence in the wisdom of their action and of the harmonious ratification by the people of the result of their labors."

In the preceding April there had been held a referendum on granting equal suffrage to white and colored voters. There could not have been very many Negroes in the State, yet this issue bobbed up because of the undercurrent of unrest regarding racial matters. This constitutional ballot covered the 25 organized counties then comprising the territory.

Equal suffrage was defeated over 2 to 1, or about 14,000 ballots being cast for white supremacy and 6,500 favoring an open field for all males regardless of color. Equality at the polls won in 6 counties and lost in 19.

In this connection it is interesting to observe the origin of the makers of the State's constitution. There was no man enrolled from the deep South, but the prevailing number were settlers who had but recently arrived in the territory from New York and New England. The leading professions were just about as legislatures are often constituted today, with 31 farmers and 20 lawyers heading the list. The range in their ages was from 25 to 65 years.

Reflecting the Gold Rush anniversary that is also being celebrated in California this year, a piece is clipped and quoted from the oldest newspaper in my State, for March 1848:

"There was some excitement on our streets yesterday, occasioned by the assembling and departure of several small companies of emigrants, bound for California. Seven covered wagons drawn by oxen left in the course of the day, carrying about 25 persons with supplies of all sorts for one year's consumption. The emigrants generally are young men of excellent habits and great energy. They hope to reach the gold diggings by August or September."

FOLK LORE and human history would not be complete in this country without including the lures and wiles of the patent medicine vendor. The newspapers of my State in the year of its nativity were full of the paid insertions of the Empire Company, an Eastern concern that made many flamboyant claims and probably sold plenty of nostrums.

For instance note these two instances: "The hair gloss of the wonderful singer Jenny Lind is now deposited with the Empire Co. It is called Jenny Lind Hair Gloss. This company is incorporated by the State of New York and has a standing above all imputations of humbuggery upon the public. . . ."

"Great Indian Remedy, Nervine Balsam, by Empire Co. $10 a box, 176 Broadway, N. Y. Rush's celebrated health pills for all bilious complaints,

and a cure for the deaf; Green's Oxygenated Bitters, for cure of dyspepsia and uterine derangements."

One of the local tooth-fixers showed enterprise enough to advertise as follows: "Cleaning, filling and inserting teeth by pivot and plate work. Do not let procrastination rob you of your teeth and deform that human face divine."

PAMPHLET and book vendors had their fling. In Songs of the People, a display announcement avers that such titles as these, edited by A. G. Emerick, were noteworthy and popular: Hail Columbia, Star Spangled Banner, Hull's Victory, Dandy Jim of Caroline, The Minute Gun at Sunset, A Merry Christmas Home, the Boy of Biscay, Buena Vista, Coming Through the Rye, and Peaceful Slumbers on the Ocean. Now we know what the founders were singing outside of their serious Sabbath devotions.

To those youthful swains who desired to hire a hack so they could give their sweethearts an airing in the moonlight while caroling some of these wistful ballads, a certain liveryman advertised in the weekly palladium thus: "Joel Mann's Livery Stable—I do not claim that I have the very best of horses and carriages; but to palm off some old nag and an old quill wheel of a buggy to anyone who wants the best is not the way I do business."

If any of those happy young couples had ambitions to teach, they might have seen this notation in the current publications, setting forth the terms and conditions for students of the State teachers' college: "Whitewater Institute; sixth fall term opened and winter term announced. Fees per quarter, primary department, $2; senior class in arithmetic and chemistry, $2.50; and Latin and Greek classes, $3.50." It is encouraging to see how much more the classic language course was prized, which shows that the early arrivals deemed that ancient tongues were valuable in a new and robust country.

Facetious quips at the expense of town characters were often seen, such as this nuptial note: "Editor gets hugged—married on 20th instant, W. H. Chandler, Evansville Journal, to Miss Rebecca Jane Hugg." Again a comic slant appeared in a local drug store notice, as follows: "The man who has been stealing wood from the pile back of the Bliss drug store is informed that the proprietor has a number of sticks too long for his stove lying around loose, and he would ask the thief to take these instead of taking sticks off the pile, if they will answer his turn as well.—Almanacs for 1848 are ready, first come, first served."

Anticipating the future days when the chinch bug would drive the pioneer grain farmer into dairying and finally make over the little private cheese factory into a cooperative one serving a whole area, a newspaper note of 1848 reports a fabulous cheese made in Licking County, Ohio. "It took the milk of 100 cows for 4 days, and it was 48 inches in diameter and 16 inches thick and weighed 3,000 pounds." Larger sizes than Ohio pioneers produced have since been commonly manufactured, especially for fair display purposes.

FOREIGN intelligence occupied fair amount of space in the local newspapers circulating through the State in 1848. Naturally, Mexican affairs had been in the limelight, so that quite a feature was made of the attempt of some playful American soldiers to get an orchestra in a theater at Mexico City to play Yankee Doodle. The same issue reported incidents of a public reception given to honor several high ranking officers of the Mexican campaign. The enthusiastic reporter slung the ink in furious style after partaking of the refreshments at the St. Charles hotel in New Orleans. He said that the brilliant assemblage in the "saloon" included these:

"The gallant Gen. Shields, complexion bronzed, his arm hanging in a sling and his eyes lit brilliantly with martial

fire." It spoke of "Major General Quitman, first American governor of the proud city of Mexico, with a form that seemed wrought in iron—a man of towering height and gigantic frame, a chest like that of Hercules and an eye like that of Mars."

ON another column of the same issue Washington news appeared. While there were no trained seals to serve as columnists and critics, the facts were often related with gusto. It remarked that four former members of the Cabinet now meet again in Washington as Senators. They were Webster of Massachusetts, Crittenden of Kentucky, Badger of North Carolina, and Bell of Tennessee.

Detailed accounts appeared about the overland experiences of John C. Fremont in his irratic and hectic career in California. There is also a series of educational articles in the papers of that year concerned with the best route to take in going to the gold fields. The warnings as to the risks incident to choosing the Isthmus of Panama and the sea route to California are frequent. One who had traveled that route and lived to relate its disadvantages wrote: "Save me and my friends, and God save you, good reader, from the Isthmus. The land is infested with lizards, gallinippers, and scorpions, and the heat is terrific." He laid most of the blame for advertising the lure of this southern route to the avaricious New York speculators and swindlers.

To boom the letter-writing urge, some comment was made on the rapid expansion of mail matter at the advent of cheap postage. The "astounding" sum of seven million dollars in two years was noted by the Postmaster General, reflecting the popularity of the mails under the cheaper postage rate. "This system," he declared, "is one of the means of increasing civilization and one of the best cements for union and peace." (The good man overestimated the power of postal services in the last case.)

Much as these typical excerpts from yellowed files bespeak some timely slants on the ideology of the year of statehood, the most of the best of it lies forever buried in the graves of the folks who laid our cornerstones. Yet I do not presume that humanity has altered over much in 100 years, at least in its basic attributes. We who help observe this anniversary cannot imagine what advances will be made in the next century, so all we can hope for is that the newer power and knowledge we acquire and pass on to the next generations will be used for the upbuilding of the dignity and the decency of this hemisphere united with a wider horizon for all mankind.

FOR the lives and fortunes of our forefathers were not cast in such huge and complex molds as the destinies of this day and age prescribe. The men of 1848 were refugees in part from undesirable conditions, both in our older communities and in the lands across the sea. They had the means and the inclination to escape these tight and stifling environments. They had a vision, somewhat mean and blurred, it is true sometimes, but a vision just the same—of a brighter and a better kind of human relationship; and then and subsequently by degrees of painful effort much of that great goal has been attained.

My hope and fervent wish is that when another century rolls by and the states and cities start anew to mark their milestones we shall have been credited in some small way with mixing some of the mortar with which the nobler structure of world democracy rises to the sky.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (General)

Reprints

N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
H-12-42 Wartime Contribution of the American Potash Industry
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
FF-8-43 Potash for Citrus Crops in California
A-1-44 What's in That Fertilizer Bag?
H-2-44 Efficient Fertilizers for Potato Farms
AA-8-44 Florida Knows How to Fertilize Citrus
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—the Aristocrat
DD-5-45 A Case of Combined Potassium and Boron Deficiencies in Grapes
GG-6-45 Know Your Soil
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
TT-10-45 Kudzu Responds to Potash
ZZ-11-45 First Things First in Soil Fertility
H-2-46 Plow-sole Placed Plant Food for Better Crop Production
S-4-46 Plow-under Fertilizer Ups Corn Yields
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
HH-6-46 Mistakes Versus Essentials of Pond Management for Fish
NN-10-46 Soil Testing—A Practical Aid to the Grower & Industry
WW-11-46 Soil Requirements for Red Clover
ZZ-12-46 Alfalfa—A Crop to Utilize the South's Resources
A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
B-1-47 The Use of Dipicrylamine in Tissue Testing for Potash
C-2-47 Research Points the Way for Higher Corn Yields in North Carolina
I-2-47 Fertilizers and Human Health
K-2-47 Potash Pays for Peas at Chehalis, Washington
N-3-47 Efficient Management for Abundant Pastures
P-3-47 Year-round Grazing
Q-4-47 Fertilizers for Sugar Beets
S-4-47 Rice Nutrition in Relation to Stem Rot of Rice
T-4-47 Fertilizer Practices for Profitable Tobacco
V-4-47 Don't Feed Alfalfa at the "Second Table"
Y-5-47 Increasing Grain Production in Mississippi
Z-5-47 Building and Maintaining Good Lawns
AA-5-47 The Potassium Content of Farm Crops
BB-5-47 More Palatable Grass Is More Nutritious
DD-6-47 Profitable Soybean Yields in North Carolina
GG-6-47 Corrective Measures for the Salinity Problem in Southwestern Soils
II-8-47 Whole-farm Demonstrations
MM-8-47 Fertilizing Potatoes Economically in Aroostook County, Maine
NN-10-47 Let's Replace Guessing with Soil Testing
PP-10-47 Potash Fertilization of Alfalfa in Connecticut
SS-10-47 Soil Fertility and Management Govern Cotton Profits
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
XX-11-47 Fall and Winter Grazing in Mississippi
YY-11-47 Boron for Vermont Farms
ZZ-11-47 Some Things to Think About
AAA-12-47 Soil Aeration and Crop Response to Fertilizers—1947
BBB-12-47 The Management of Mint Soils
CCC-12-47 Do Soybeans Cause Clover Failures?
DDD-12-47 Florida Grows Good Pasture on Coastal Plain Soils
A-1-48 Let's Foster Fertility
B-1-48 Potash Supplies for 1948
C-1-48 Fertilizers Double and Treble Grain Yields in Northern Wisconsin
D-1-48 A Good Combination: Lespedeza Sericea and Crimson Clover
E-2-48 Root Rot of Sweet Clover Reduced by Soil Fertility
F-2-48 Swapping Plant Food for Corn
H-2-48 Soil Testing and Soil Conservation
I-2-48 Success with Alfalfa in Alabama
J-2-48 The New Frontier for Midwestern Farmers
K-3-48 Peanut Land and What It Needs
L-3-48 Radioisotopes: An Indispensable Aid to Agricultural Research
M-3-48 Hitting the Target: 100 Bu. Corn Per A.
N-3-48 Ground Cover
O-4-48 Legumes Improve Drainage and Reduce Erosion
P-4-48 Farm Problems of the Cotton Belt
Q-4-48 A 5,000-Acre Water Garden?
R-4-48 Needs of the Corn Crop
S-4-48 Organic Matter and Our Food Supply
T-4-48 Winter Grazing Increases Southern Livestock Profits

THE AMERICAN POTASH INSTITUTE
1155 16TH STREET, N. W. WASHINGTON 6, D. C.

Two young women were visiting Rockefeller Center, in New York. They were examining the statue of Prometheus, when one of them asked, "Who's that supposed to be?"

"Are you kidding?" rejoined the other. "Why, that's Promiscuous!"

* * *

Uncle Jeff was telling about the death of a nephew.

"Whut wuz de complaint?" a listener asked.

"Wuzn't no complaint; everybody wuz satisfied," said the old Negro.

* * *

COINCIDENCE

I crept upstairs, my shoes in hand,
Just as the night took wing—
And I saw my wife, four steps above,
Doing the same darned thing.

* * *

Dean of Women: "Why did you come to college?"

Coed: "I came to be went with, but I ain't yet!"

* * *

Aunt Becky was punctuating the Negro preacher's sermon with "Amen! Amen! . . . Praise de Lawd! . . ." as he lit into every sort of sin from murder to card playing. Then the parson moved on against gossiping and Aunt Becky exclaimed to her neighbor indignantly, "Dar now! He's done stopped preachin' and gone to meddlin'!"

* * *

A man will always go to bat for a girl if she has the right kind of curves.

* * *

A case worker at the Welfare agency in a southern town was interviewing an applicant who asked for aid for herself and her 13 children.

"But I don't understand," the case worker said in surprise. "You say your husband deserted you ten years ago, yet eight of your children are under ten years of age."

"Oh, I can explain that, yes, ma'am," said the applicant beaming. "You see he came back now and then to apologize."

* * *

One tried and sure method of getting your wife home soon from an out-of-town vacation is to send her a copy of the local paper with one item clipped out.

* * *

HE COMPLIED

Madge: "And what did he do when you told him you didn't want to see him any more?"

Milly: "He up and turned out the lights."

* * *

Overheard at the railroad station: "Has the train for Jackson left yet?"

Porter: "No, suh, but she's atwiching."

FERTILIZER BORATE

more economical

FOR AGRICULTURE

Authorities have recognized that the depletion of Boron in soil has been reflected in limited production and poor quality of numerous field and fruit crops.

Outstanding results have been obtained with the application of Borax in specific quantities, or as part of the regular fertilizer mix, improving the quality and increasing the production of alfalfa and other legumes, table beets, sugar beets, apples, etc.

The work and recommendations of the State Agricultural Stations and County Agents are steadily increasing the recognition of the need for Boron in agriculture.

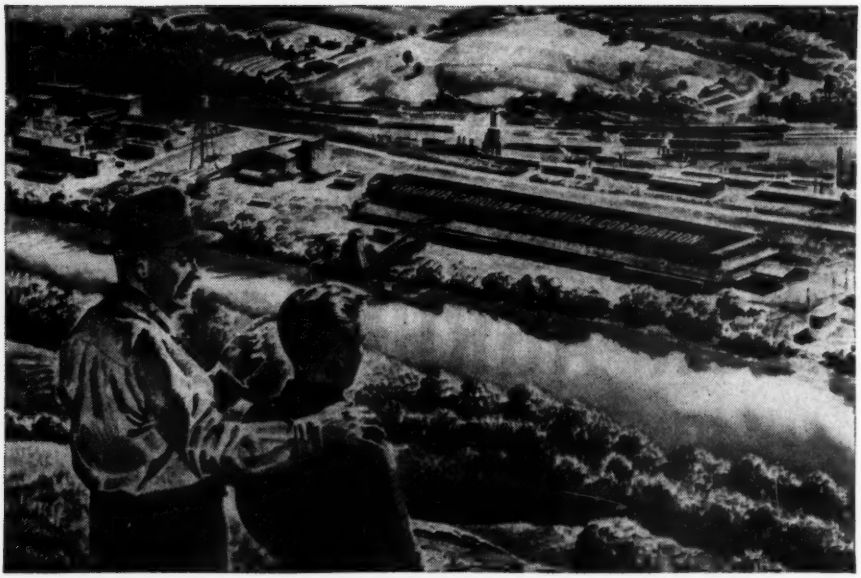
Boron is a plant food element and is commonly obtained from Borax since the element does not occur in the pure form. Fertilizer Borate is a semi-refined product containing 93% Borax.

Fertilizer Borate was placed on the market by the makers of "20 Mule Team Borax" as a fertilizer grade product to save cost of refining and hence to supply Borax at the lowest cost.

Fertilizer Borate is packed in 100 lb. sacks. Address your inquiries to the nearest office.

PACIFIC COAST BORAX CO.

NEW YORK • CHICAGO • LOS ANGELES



"That Factory is Our Farm's Best Friend"

IN MANY COMMUNITIES in many states, farmers look upon the local V-C factory as an old and trusted friend.

For economy and convenience, each V-C factory is located near the farms it serves. Yet each factory benefits from the scientific research, experience, skill and facilities of a national organization.

Through its network of 36 fertilizer factories, its phosphate rock mines, its 21 sulphuric acid plants, its 28 superphosphate producing units, and its analytical and research laboratories, the V-C organization is helping to make farming a better-paying business in every state from the Rocky Mountains to the Atlantic and from Canada to the Gulf of Mexico.

Virginia-Carolina Chemical Corporation is superbly equipped with men, mines and factories to produce the right plant-food mixture for every crop on every soil. Backed by this great national organization, each individual local V-C factory concentrates on supplying the particular plant-food needs of the farms in the territory it serves.

Farm folks, everywhere, like this efficient V-C method of manufacturing and selling honest and dependable fertilizers which produce the utmost in extra yields of profitable crops. Through the years, Virginia-Carolina Chemical Corporation has continued to win and hold the loyal friendship of more and more V-C customers—reliable agents and dealers and thousands of good farmers who try V-C Fertilizers and then keep on buying and using V-C Fertilizers.

VIRGINIA-CAROLINA CHEMICAL CORPORATION

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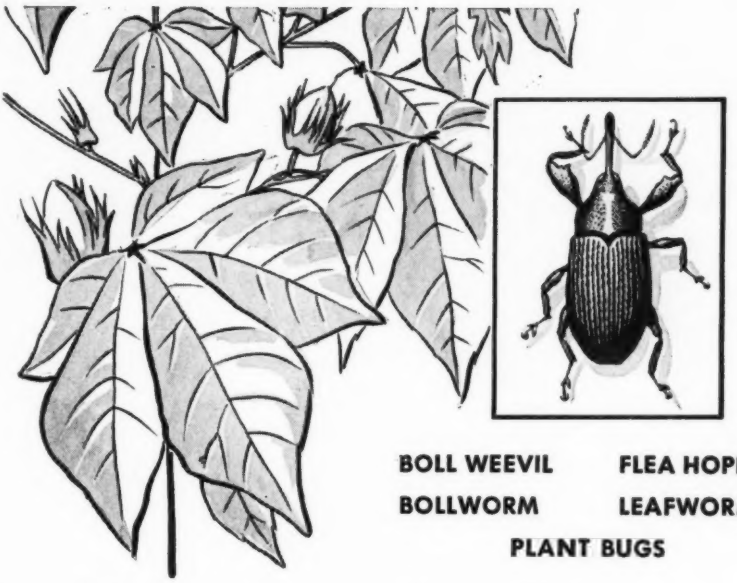
VC FERTILIZERS

Make the good earth better!

New "U.S." Toxaphene Formulations

for Cotton Insect Control



BOLL WEEVIL **FLEA HOPPER**
BOLLWORM **LEAFWORM**
PLANT BUGS

TOXAPHENE-20
a dust to control cotton Boll Weevil and Bollworm, cotton Flea Hopper, cotton Leafworm, Thrips, Southern Green Stink Bug, Rapid Plant Bug and Tarnished Plant Bug.

Dosage: 10 lbs. per acre

TOXAPHENE-S-20
contains 40% sulphur to control Red Spider in addition to insects listed above.

Dosage: 10-15 lbs. per acre

Write for technical data sheet and name of nearest dealer.

UNITED STATES RUBBER COMPANY

SERVING THROUGH SCIENCE

Agricultural Chemical Division

1230 Rockefeller Center, New York 20, N. Y.

THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

OTHER 16MM. COLOR FILMS AVAILABLE FOR TERRITORIES INDICATED

Potash in Southern Agriculture (South)
In the Clover (Northeast)
Bringing Citrus Quality to Market (West)
Machine Placement of Fertilizer (West)
Ladino Clover Pastures (West)
Potash from Soil to Plant (West)
Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)
Borax From Desert to Farm (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

American Potash Institute
1155 Sixteenth Street
Washington 6, D. C.

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